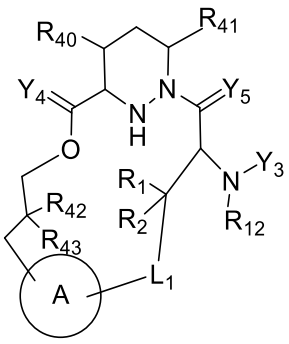
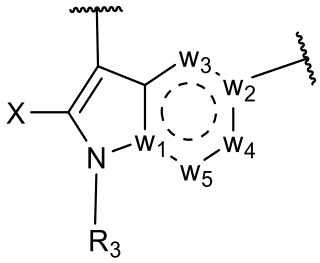
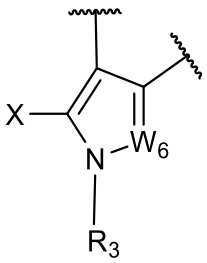
## CLAIMS

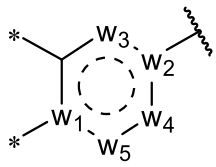
1. A compound represented by formula (I), or a stable deuterated derivative thereof, or a stereoisomer thereof, or a pharmaceutically acceptable salt thereof, a solvate thereof, or a prodrug thereof:



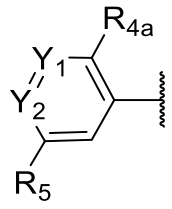
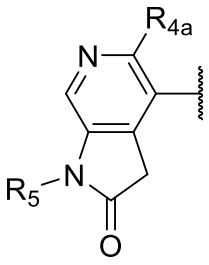
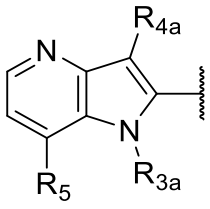
(I)

wherein,

ring A is  or  ;

 is phenyl, 5- or 6-membered heteroaryl, or 5- or 6-membered heterocyclyl; 1 or 2 ring atoms of the 5- or 6-membered heteroaryl are heteroatoms selected from nitrogen, oxygen, and sulfur; 1 or 2 ring atoms of the 5- or 6-membered heterocyclyl are heteroatoms selected from nitrogen, oxygen, and sulfur; the 5- or 6-membered heterocyclyl is fully saturated heterocyclyl or partially unsaturated heterocyclyl; or wherein, $W_1$ is CH, C, or N; $W_2$ is CH, C, or N; $W_3$ is $CR_{13}$, O, S, N, or NH; $W_4$ is $CR_{13}$, O, S, N, or NH; $W_5$ is absent, O, or $CR_{14}$; * indicates a linking site to the moiety on the left;

$W_6$ is selected from $CR_{13}$ and N;

X is  ,  , or  ;

$Y_1$ is N or CH, wherein N can be oxidized ($N^+$-$O^-$);

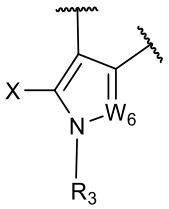
$Y_2$ is N or CH, wherein N can be oxidized ($N^+$-$O^-$);

$R_{42}$ is hydrogen, halogen, or substituted or unsubstituted $C_{1-6}$ alkyl; $R_{43}$ is hydrogen, halogen, or substituted or unsubstituted $C_{1-6}$ alkyl; or

$R_{42}$ and $R_{43}$, together with the carbon atom to which they are attached, form substituted or unsubstituted $C_{3-6}$ cycloalkyl or substituted or unsubstituted 3- to 8-membered heterocyclyl;

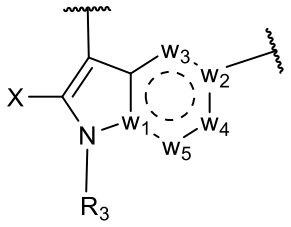
$R_{40}$ is hydrogen, halogen, or substituted or unsubstituted $C_{1-6}$ alkyl; $R_{41}$ is hydrogen, halogen, or substituted or unsubstituted $C_{1-6}$ alkyl; or

$R_{40}$ and $R_{41}$ are linked to form $-CH_2-$ or $-CH_2CH_2-$, wherein the $-CH_2-$ or $-CH_2CH_2-$ is optionally substituted with one or more groups selected from deuterium, halogen, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, and deuterated $C_{1-6}$ alkyl;

when ring A is  , $L_1$ is $-N(R_{00})C(=O)-$, $-N(R_{00})C(=O)-O-$, $-C_{1-4}$ alkyl-$N(R_{00})C(=O)-$, $-C(=O)N(R_{00})-C_{1-4}$ alkyl-, $-C_{1-4}$ alkyl-$N(R_{00})C(=S)-$, -substituted or unsubstituted $C_{1-6}$ alkyl-O-, -substituted or unsubstituted $C_{2-6}$ alkenyl-O-, substituted or unsubstituted $C_{3-6}$ cycloalkyl, substituted or unsubstituted 3- to 8-membered heterocyclyl, substituted or unsubstituted $C_{6-10}$ aryl, substituted or unsubstituted 5- or 6-membered monocyclic heteroaryl, substituted or unsubstituted 8- to 10-membered bicyclic heteroaryl, $-L_2$-substituted or unsubstituted $C_{6-10}$ aryl-, $-L_2$-substituted or unsubstituted 5- or 6-membered monocyclic heteroaryl-, $-L_2$-substituted or unsubstituted 8- or 10-membered bicyclic heteroaryl-, or $-L_2$-substituted or unsubstituted 3- to 8-membered

heterocyclyl-;

$L_2$ is $C_{3-6}$ cycloalkyl, 3- to 8-membered heterocyclyl, -O-, -$C_{1-4}$ alkyl-, -N($R_{00}$)-, -C(=O)-, -$CR_{09}$=$CR_{10}$-, -N($R_{00}$)C(=O)-, or -N($R_{00}$)C(=S)-;

when ring A is 

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when at least one of $W_1$, $W_2$, $W_3$, $W_4$, and $W_5$ is a heteroatom selected from O, S, N, and NH, $L_1$ is -N($R_{00}$)C(=O)-, -N($R_{00}$)C(=O)-O-, -$C_{1-4}$ alkyl-N($R_{00}$)C(=O)-, -C(=O)N($R_{00}$)-$C_{1-4}$ alkyl-, -$C_{1-4}$ alkyl-N($R_{00}$)C(=S)-, -substituted or unsubstituted $C_{1-6}$ alkyl-O-, -substituted or unsubstituted $C_{2-6}$ alkenyl-O-, substituted or unsubstituted $C_{3-6}$ cycloalkyl, substituted or unsubstituted 3- to 8-membered heterocyclyl, substituted or unsubstituted $C_{6-10}$ aryl, substituted or unsubstituted 5- or 6-membered monocyclic heteroaryl, substituted or unsubstituted 8- to 10-membered bicyclic heteroaryl, -$L_2$-substituted or unsubstituted $C_{6-10}$ aryl-, -$L_2$-substituted or unsubstituted 5- or 6-membered monocyclic heteroaryl-, or -$L_2$-substituted or unsubstituted 3- to 8-membered heterocyclyl-;

$L_2$ is -O-, -$C_{1-4}$ alkyl-, -N($R_{00}$)-, -C(=O)-, -$CR_{09}$=$CR_{10}$-, -N($R_{00}$)C(=O)-, or -N($R_{00}$)C(=S)-;

or,

when $W_1$ and $W_2$ are both C, and $W_3$, $W_4$, and $W_5$ are all CH, $L_1$ is -N($R_{00}$)C(=O)-O-, -$C_{1-4}$ alkyl-N($R_{00}$)C(=O)-, -N($R_{00}$)C(=O)-$C_{1-4}$ alkyl-, -$C_{1-4}$ alkyl-N($R_{00}$)C(=S)-, -substituted or unsubstituted $C_{1-6}$ alkyl-O-, or -substituted or unsubstituted $C_{2-6}$ alkenyl-O-;

$R_{00}$ is hydrogen or $C_{1-6}$ alkyl;

$R_1$ is hydrogen, deuterium, halogen, hydroxy, $C_{1-6}$ alkyl, or substituted or unsubstituted $C_{1-6}$ heteroalkyl;

$R_2$ is hydrogen, deuterium, halogen, $C_{1-6}$ alkyl, or substituted or unsubstituted $C_{1-6}$ heteroalkyl;

$R_{3a}$ is $C_{1-6}$ alkyl or deuterated $C_{1-6}$ alkyl;

$R_{4a}$ is substituted or unsubstituted $C_{1-6}$ alkyl, substituted or unsubstituted $C_{3-6}$ cycloalkyl, or substituted or unsubstituted 3- to 8-membered heterocyclyl;

$R_5$ is hydrogen, $-NR_{01}R_{02}$, $-C(R_{05})R_{03}R_{04}$, $-C_{1-4}$ alkyl-$NR_{01}R_{02}$, $-C_{1-4}$ alkyl-$C(R_{05})R_{03}R_{04}$, $-C_{1-4}$ alkyl-$C(=O)$-$NR_{01}R_{02}$, $-C_{1-4}$ alkyl-$C(=O)$-$C(R_{05})R_{03}R_{04}$, $-C_{1-4}$ alkyl-$C(=O)$-$C_{1-4}$ alkyl-$NR_{01}R_{02}$, $-C_{1-4}$ alkyl-$C(=O)$-$C_{1-4}$ alkyl-$C(R_{05})R_{03}R_{04}$, $-C_{1-4}$ alkyl-$N(R_{06})C(=O)$-$NR_{01}R_{02}$, $-C_{1-4}$ alkyl-$N(R_{06})C(=O)$-$C(R_{05})R_{03}R_{04}$, $-C_{1-4}$ alkyl-$N(R_{06})C(=O)$-$C_{1-4}$ alkyl-$NR_{01}R_{02}$, $-C_{1-4}$ alkyl-$N(R_{06})C(=O)$-$C_{1-4}$ alkyl-$C(R_{05})R_{03}R_{04}$, $-O$-$C_{1-4}$ alkyl-$NR_{01}R_{02}$, $-O$-$C_{1-4}$ alkyl-$C(R_{05})R_{03}R_{04}$, $-O$-$C_{1-4}$ alkyl-$N(R_{06})C(=O)$-$R_{03}$, $-O$-$C(R_{05})R_{03}R_{04}$, $-C_{1-4}$ alkyl-$NR_{01}R_{02}$, $-C_{1-4}$ alkyl-$C(R_{05})R_{03}R_{04}$, $-N(R_{06})C(=O)$-$NR_{01}R_{02}$, $-N(R_{06})C(=O)$-$C(R_{05})R_{03}R_{04}$, $-C_{2-4}$ alkynyl-$NR_{01}R_{02}$, $-C_{2-4}$ alkynyl-$C(=O)$-$NR_{01}R_{02}$, $-C_{2-4}$ alkynyl-$C(R_{05})R_{03}R_{04}$, $-C_{1-4}$ alkyl-$C_{2-4}$ alkynyl-$NR_{01}R_{02}$, $-C_{1-4}$ alkyl-$C_{2-4}$ alkynyl-$C(R_{05})R_{03}R_{04}$, $-C_{2-4}$ alkynyl-$C_{1-4}$ alkyl-$NR_{01}R_{02}$, $-C_{2-4}$ alkynyl-$C_{1-4}$ alkyl-$C(R_{05})R_{03}R_{04}$, $-C_{1-4}$ alkyl-$C_{2-4}$ alkynyl-$C_{1-4}$ alkyl-$NR_{01}R_{02}$, $-CH=CR_{01}R_{02}$, $-C_{2-4}$ alkenyl-$NR_{01}R_{02}$, $-C_{2-4}$ alkenyl-$C(R_{05})R_{03}R_{04}$, $-C_{1-4}$ alkyl-$C_{2-4}$ alkenyl-$NR_{01}R_{02}$, $-C_{1-4}$ alkyl-$C_{2-4}$ alkenyl-$C(R_{05})R_{03}R_{04}$, $-C_{2-4}$ alkenyl-$C_{1-4}$ alkyl-$NR_{01}R_{02}$, $-C_{2-4}$ alkenyl-$C_{1-4}$ alkyl-$C(R_{05})R_{03}R_{04}$, $-C_{1-4}$ alkyl-$C_{2-4}$ alkenyl-$C_{1-4}$ alkyl-$NR_{01}R_{02}$, $-C=CR_{03}R_{04}$, $-O$-$C_{1-4}$ alkyl-substituted or unsubstituted 3- to 8-membered monocyclic heterocyclyl, $-O$-$C_{1-4}$ alkyl-substituted or unsubstituted 5- to 15-membered tricyclic heterocyclyl, $-O$-$C_{1-4}$ alkyl-substituted or unsubstituted 7- to 12-membered bicyclic heterocyclyl, -O-substituted or unsubstituted 3- to 8-membered monocyclic heterocyclyl, -O-substituted or unsubstituted 5- to 15-membered tricyclic heterocyclyl, -O-substituted or unsubstituted 7- to 12-membered bicyclic heterocyclyl, $-N=S(=O)(R_{06})(-C_{1-4}$ alkyl-$NR_{01}R_{02})$, $-N(R_{06})$-$S(=O)(-C_{1-4}$ alkyl-$NR_{01}R_{02})$, $-S(=O)(R_{06})(=N$-$R_{06})$, $-S(=O)(-C_{1-4}$ alkyl-$NR_{01}R_{02})(=N$-$R_{06})$, $-S(=O)_2(-C_{1-4}$ alkyl-$NR_{01}R_{02})$, $-S(=O)(-C_{1-4}$ alkyl-$NR_{01}R_{02})$, $-S(=O)_2(-C_{1-4}$ alkyl-$C(R_{05})R_{03}R_{04})$, $-S(=O)(-C_{1-4}$ alkyl-$C(R_{05})R_{03}R_{04})$, $-C_{2-4}$ alkynyl-substituted or unsubstituted 5- or 6-membered monocyclic heteroaryl, $-C_{2-4}$ alkynyl-substituted or unsubstituted 8- to 10-membered bicyclic heteroaryl, $-C_{2-4}$ alkynyl-substituted or unsubstituted 6- to 12-membered heteroaryl-fused heterocyclyl, substituted or unsubstituted $C_{6-10}$ aryl, substituted or unsubstituted 5- or 6-membered

monocyclic heteroaryl, substituted or unsubstituted 8- to 10-membered bicyclic heteroaryl, substituted or unsubstituted $C_{6-10}$ aryl-substituted or unsubstituted 3- to 8-membered monocyclic heterocyclyl, substituted or unsubstituted 5- or 6-membered monocyclic heteroaryl-substituted or unsubstituted 3- to 8-membered monocyclic heterocyclyl, substituted or unsubstituted $C_{6-10}$ aryl-$C_{1-4}$ alkyl-substituted or unsubstituted 3- to 8-membered monocyclic heterocyclyl, substituted or unsubstituted 5- or 6-membered monocyclic heteroaryl-$C_{1-4}$ alkyl-substituted or unsubstituted 3- to 8-membered monocyclic heterocyclyl, substituted or unsubstituted $C_{6-10}$ aryl-fused substituted or unsubstituted 3- to 8-membered monocyclic heterocyclyl, substituted or unsubstituted 5- or 6-membered monocyclic heteroaryl-fused substituted or unsubstituted 3- to 8-membered monocyclic heterocyclyl, substituted or unsubstituted $C_{6-10}$ aryl-$C_{1-4}$ alkyl-$NR_{01}R_{02}$, or substituted or unsubstituted 5- or 6-membered monocyclic heteroaryl-$C_{1-4}$ alkyl-$NR_{01}R_{02}$;

$R_{01}$ and $R_{02}$ are each independently selected from hydrogen, substituted or unsubstituted $C_{1-6}$ alkyl, substituted or unsubstituted $C_{1-6}$ alkoxy, substituted or unsubstituted $C_{3-6}$ cycloalkyl, substituted or unsubstituted $C_{2-6}$ alkenyl, and substituted or unsubstituted $C_{2-6}$ alkynyl; or

$R_{01}$ and $R_{02}$, together with the nitrogen atom to which they are attached, form substituted or unsubstituted 5- to 15-membered tricyclic heterocyclyl, substituted or unsubstituted 7- to 12-membered bicyclic heterocyclyl, or substituted or unsubstituted 3- to 8-membered monocyclic heterocyclyl;

$R_{03}$ and $R_{04}$ are each independently selected from hydrogen, substituted or unsubstituted $C_{1-6}$ alkyl, substituted or unsubstituted $C_{1-6}$ alkoxy, substituted or unsubstituted $C_{2-6}$ alkenyl, and substituted or unsubstituted $C_{2-6}$ alkynyl, wherein 2 hydrogen atoms on the same carbon atom of the $C_{1-6}$ alkyl or $C_{1-6}$ alkoxy are optionally both substituted with $-(CH_2)_j-$ to form cycloalkyl, wherein j is 2, 3, 4, 5, or 6; or

$R_{03}$ and $R_{04}$, together with the carbon atom to which they are attached, form substituted or unsubstituted 5- to 15-membered tricyclic heterocyclyl, substituted or unsubtituted 7- to 12-membered bicyclic heterocyclyl, substituted or

unsubstituted 3- to 8-membered monocyclic heterocyclyl, substituted or unsubstituted 5- or 6-membered monocyclic heteroaryl, or substituted or unsubstituted 8- to 10-membered bicyclic heteroaryl;

$R_{05}$ is hydrogen, deuterium, halogen, deuterated $C_{1-6}$ alkyl, or $C_{1-6}$ alkyl;

$R_{06}$ is hydrogen, deuterium, or $C_{1-6}$ alkyl;

$Y_3$ is $-C(=O)R_6$, $-C(=S)R_6$, $-S(=O)(R_{07})(=N-R_{08})$, $-S(=O)(R_{07})(R_{08})$, $-S(=O)_2(R_{07})(R_{08})$, $-P(=O)(R_{07})(R_{08})$, $-C(=O)-C_{1-4}$ alkyl-$NR_6-S(=O)(R_{07})(=N-R_{08})$, $-C(=O)-C_{1-4}$ alkyl-$N=S(=O)(R_{07})(R_{08})$, or $R_{11}$; $R_{12}$ is hydrogen, $C_{1-6}$ alkyl, or deuterated $C_{1-6}$ alkyl; or,

$Y_3$ and $R_{12}$, together with the nitrogen atom to which they are attached, form substituted or unsubstituted nitrogen-containing 3- to 8-membered heterocyclyl; in the nitrogen-containing 3- to 8-membered heterocyclyl, one ring atom is a nitrogen atom, and optionally one or more (e.g., 1, 2, or 3) ring atoms are heteroatoms selected from nitrogen, oxygen, sulfur, and phosphorus;

$R_6$ is substituted or unsubstituted $C_{1-6}$ alkyl, substituted or unsubstituted $C_{1-6}$ heteroalkyl, substituted or unsubstituted $C_{3-6}$ cycloalkyl, substituted or unsubstituted 3- to 8-membered heterocyclyl, substituted or unsubstituted $C_{6-10}$ aryl, substituted or unsubstituted 5- or 6-membered monocyclic heteroaryl, or substituted or unsubstituted 8- to 10-membered bicyclic heteroaryl;

$R_{11}$ is substituted or unsubstituted 3- to 10-membered heterocyclyl, substituted or unsubstituted 5- or 6-membered monocyclic heteroaryl, substituted or unsubstituted 8- to 10-membered bicyclic heteroaryl, substituted or unsubstituted 6- to 12-membered heteroaryl-fused cycloalkyl, substituted or unsubstituted 6- to 12-membered heteroaryl-fused heterocyclyl, substituted or unsubstituted 7- to 12-membered bicyclic heterocyclyl, or substituted or unsubstituted 5- to 15-membered tricyclic heterocyclyl;

$R_{07}$ is hydrogen, deuterium, substituted or unsubstituted $C_{1-6}$ alkyl, or substituted or unsubstituted $C_{3-6}$ cycloalkyl; the substitutions refer to substitutions with one or more (e.g., 1, 2, 3, or 4) groups selected from the following group consisting of: deuterium, $C_{1-6}$ alkyl, $C_{1-6}$ heteroalkyl, and 5- or 6-membered monocyclic heteroaryl;

$R_{08}$ is hydrogen, deuterium, substituted or unsubstituted $C_{1-6}$ alkyl, or substituted or unsubstituted $C_{3-6}$ cycloalkyl; the substitutions refer to substitutions with one or more (e.g., 1, 2, 3, or 4) groups selected from the following group consisting of: deuterium, $C_{1-6}$ alkyl, $C_{1-6}$ heteroalkyl, and 5- or 6-membered monocyclic heteroaryl;

$R_{09}$ is hydrogen, deuterium, halogen, or substituted or unsubstituted $C_{1-6}$ alkyl; the substitution refers to substitution with one or more (e.g., 1, 2, 3, or 4) groups selected from the following group consisting of: deuterium and halogen;

$R_{10}$ is hydrogen, deuterium, halogen, or substituted or unsubstituted $C_{1-6}$ alkyl; the substitution refers to substitution with one or more (e.g., 1, 2, 3, or 4) groups selected from the following group consisting of: deuterium and halogen;

$Y_5$ is O or S;

$Y_4$ is O or S;

$R_3$ is hydrogen, substituted or unsubstituted $C_{1-6}$ alkyl, substituted or unsubstituted $C_{1-6}$ heteroalkyl, substituted or unsubstituted $C_{2-6}$ alkenyl, substituted or unsubstituted $C_{2-6}$ alkynyl, substituted or unsubstituted $C_{3-6}$ cycloalkyl, substituted or unsubstituted 3- to 8-membered heterocyclyl, substituted or unsubstituted $C_{6-10}$ aryl, substituted or unsubstituted 5- or 6-membered monocyclic heteroaryl, or substituted or unsubstituted 8- to 10-membered bicyclic heteroaryl;

$R_{13}$ is hydrogen, halogen, substituted or unsubstituted $C_{1-6}$ alkyl, or substituted or unsubstituted $C_{1-6}$ alkoxy; $R_{14}$ is hydrogen, halogen, or substituted or unsubstituted $C_{1-6}$ alkyl; or

in $W_4$ and $W_5$, $R_{13}$ and $R_{14}$, together with the carbon atom to which they are attached, form substituted or unsubstituted $C_{3-6}$ cycloalkyl, substituted or unsubstituted $C_{6-10}$ aryl, substituted or unsubstituted 5- or 6-membered monocyclic heteroaryl, or substituted or unsubstituted 3- to 8-membered heterocyclyl; or

in $W_5$, $R_{14}$ and $R_3$, together with the atom to which they are attached, form substituted or unsubstituted nitrogen-containing 4- to 8-membered monocyclic heterocyclyl; in the nitrogen-containing 4- to 8-membered monocyclic

heterocyclyl, one ring atom is a nitrogen atom, and optionally one or more (e.g., 1, 2, or 3) ring atoms are heteroatoms selected from nitrogen, oxygen, sulfur, and phosphorus; or,

in $W_6$, $R_{13}$ and $R_3$, together with the atom to which they are attached, form substituted or unsubstituted nitrogen-containing 3- to 8-membered monocyclic heterocyclyl or substituted or unsubstituted 5- or 6-membered monocyclic heteroaryl; in the nitrogen-containing 3- to 8-membered monocyclic heterocyclyl, one ring atom is a nitrogen atom, and optionally one or more (e.g., 1, 2, or 3) ring atoms are heteroatoms selected from nitrogen, oxygen, sulfur, and phosphorus;

in the groups described above, the substitutions each independently refer to that the groups described above are each independently substituted with 1, 2, 3, 4, 5, or 6 groups selected from group S1; the groups of group S1 are each independently selected from the following group consisting of: $-SF_5$, deuterium, oxo (=O), thio (=S), $=CR^eR^f$, $=NR^e$, halogen, cyano, hydroxy, carboxyl, nitro, $C_{1-6}$ alkyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{1-6}$ alkoxy, $C_{3-20}$ cycloalkyl, 3- to 20-membered heterocyclyl, $C_{6-14}$ aryl, 5- or 6-membered monocyclic heteroaryl, 8- to 10-membered bicyclic heteroaryl, -O-$C_{3-20}$ cycloalkyl, -O-3- to 20-membered heterocyclyl, -O-$C_{6-14}$ aryl, -O-5- or 6-membered monocyclic heteroaryl, -O-8- to 10-membered bicyclic heteroaryl, -C≡C-$C_{3-20}$ cycloalkyl, -C≡C-3- to 20-membered heterocyclyl, -C≡C-$C_{6-14}$ aryl, -C≡C-5- or 6-membered monocyclic heteroaryl, -C≡C-8- to 10-membered bicyclic heteroaryl, -C≡C-$C_{1-4}$ alkyl-$C_{3-20}$ cycloalkyl, -C≡C-$C_{1-4}$ alkyl-3- to 20-membered heterocyclyl, -C≡C-$C_{1-4}$ alkyl-$C_{6-14}$ aryl, -C≡C-$C_{1-4}$ alkyl-5- or 6-membered monocyclic heteroaryl, -C≡C-$C_{1-4}$ alkyl-8 to 10-membered bicyclic heteroaryl, -$C_{1-4}$ alkyl-hydroxy, -$C_{1-4}$ alkyl-cyano, -$C_{1-4}$ alkyl-$C_{1-6}$ alkyl, -$C_{1-4}$ alkyl-$C_{1-6}$ alkoxy, -$C_{1-4}$ alkyl-$C_{3-20}$ cycloalkyl, -$C_{1-4}$ alkyl-O-$C_{3-20}$ cycloalkyl, -$C_{1-4}$ alkyl-3- to 20-membered heterocyclyl, -$C_{1-4}$ alkyl-O-3- to 20-membered heterocyclyl, -$C_{1-4}$ alkyl-$C_{6-14}$ aryl, -$C_{1-4}$ alkyl-O-$C_{6-14}$ aryl, -$C_{1-4}$ alkyl-5- or 6-membered monocyclic heteroaryl, -$C_{1-4}$ alkyl-O-5- or 6-membered monocyclic heteroaryl, -$C_{1-4}$ alkyl-8- to 10-membered bicyclic heteroaryl, -$C_{1-4}$ alkyl-O-8- to 10-membered bicyclic heteroaryl, -O-$C_{1-4}$ alkyl-hydroxy, -O-$C_{1-4}$ alkyl-cyano, -O-$C_{1-4}$ alkyl-$C_{1-6}$ alkyl, -O-$C_{1-4}$ alkyl-$C_{1-6}$ alkoxy,

-O-$C_{1-4}$ alkyl-$C_{3-20}$ cycloalkyl, -O-$C_{1-4}$ alkyl-O-$C_{3-20}$ cycloalkyl, -O-$C_{1-4}$ alkyl-3- to 20-membered heterocyclyl, -O-$C_{1-4}$ alkyl-O-3- to 20-membered heterocyclyl, -O-$C_{1-4}$ alkyl-$C_{6-14}$ aryl, -O-$C_{1-4}$ alkyl-O-$C_{6-14}$ aryl, -O-$C_{1-4}$ alkyl-5- or 6-membered monocyclic heteroaryl, -O-$C_{1-4}$ alkyl-O-5- or 6-membered monocyclic heteroaryl, -O-$C_{1-4}$ alkyl-8- to 10-membered bicyclic heteroaryl, -O-$C_{1-4}$ alkyl-O-8- to 10-membered bicyclic heteroaryl, -S(=O)$_2$-$C_{1-6}$ alkyl, -S(=O)$_2$-$C_{3-20}$ cycloalkyl, -S(=O)$_2$-3- to 20-membered heterocyclyl, -C(=O)O-$C_{1-6}$ alkyl, -C(=O)O-$C_{3-20}$ cycloalkyl, -C(=O)-$C_{1-6}$ alkyl, -C(=O)-$C_{3-20}$ cycloalkyl, -C(=O)-$C_{6-14}$ aryl, -$NR^{a1}R^{b1}$, -C(=O)-$NR^{a1}R^{b1}$, -C(=O)-$NR^{d1}$-$C_{1-4}$ alkyl-$R^{c1}$, -$OR^{c1}$, -$C_{1-4}$ alkyl-S(=O)$_2$-$C_{1-6}$ alkyl, -$C_{1-4}$ alkyl-S(=O)$_2$-$C_{3-20}$ cycloalkyl, -$C_{1-4}$ alkyl-S(=O)$_2$-3- to 20-membered heterocyclyl, -$C_{1-4}$ alkyl-C(=O)O-$C_{1-6}$ alkyl, -$C_{1-4}$ alkyl-C(=O)O-$C_{3-20}$ cycloalkyl, -$C_{1-4}$ alkyl-C(=O)-$C_{1-6}$ alkyl, -$C_{1-4}$ alkyl-C(=O)-$C_{3-20}$ cycloalkyl, -$C_{1-4}$ alkyl-C(=O)-$C_{6-14}$ aryl, -C(=O)-5- or 6-membered monocyclic heteroaryl, -C(=O)-8- to 10-membered bicyclic heteroaryl, -C(=O)-$C_{1-6}$ alkyl-$C_{3-20}$ cycloalkyl, -C(=O)-$C_{1-6}$ alkyl-3- to 20-membered heterocyclyl, -C(=O)-$C_{1-6}$ alkyl-$C_{6-14}$ aryl, -C(=O)-$C_{1-6}$ alkyl-5- or 6-membered monocyclic heteroaryl, -C(=O)-$C_{1-6}$ alkyl-8- to 10-membered bicyclic heteroaryl, -$C_{1-4}$ alkyl-$NR^{a1}R^{b1}$, -$C_{1-4}$ alkyl-C(=O)-$NR^{a1}R^{b1}$, -C≡C-C(=O)-$NR^{a1}R^{b1}$, -C≡C-$C_{1-4}$ alkyl-C(=O)-$NR^{a1}R^{b1}$, -$C_{1-4}$ alkyl-$OR^{c1}$, -$C_{1-4}$ alkyl-P(=O)-($C_{1-6}$ alkyl)$_2$, -P(=O)-($C_{1-6}$ alkyl)$_2$, -$C_{1-4}$ alkyl-$NR^{d1}$-C(=O)-$R^{c1}$, -$C_{1-4}$ alkyl-$NR^{d1}$-C(=O)-$NR^{a1}R^{b1}$, -$C_{1-4}$ alkyl-$NR^{d1}$-S(=O)$_2$-$R^{c1}$, -$C_{1-4}$ alkyl-S(=O)$_2$-$NR^{a1}R^{b1}$, -$C_{1-4}$ alkyl-$NR^{d1}$-S(=O)$_2$-$NR^{a1}R^{b1}$, -$NR^{d1}$-C(=O)-$R^{c1}$, -$NR^{d1}$-C(=O)-$C_{1-4}$ alkyl-$R^{c1}$, -$NR^{d1}$-C(=O)-$NR^{a1}R^{b1}$, -$NR^{d1}$-S(=O)$_2$-$R^{c1}$, -S(=O)$_2$-$NR^{a1}R^{b1}$, -$NR^{d1}$-S(=O)$_2$-$NR^{a1}R^{b1}$, and -P(=O)-($C_{1-6}$ alkyl)$_2$; wherein, the $C_{1-6}$ alkyl, the $C_{1-6}$ alkoxy, the $C_{2-6}$ alkenyl, and the $C_{2-6}$ alkynyl are each independently and optionally substituted with 1, 2, or 3 groups selected from halogen, deuterium, cyano, and hydroxy; the $C_{3-20}$ cycloalkyl, the 3- to 20-membered heterocyclyl, the $C_{6-14}$ aryl, the 5- or 6-membered monocyclic heteroaryl, and the 8- to 10-membered bicyclic heteroaryl are each independently and optionally substituted with 1, 2, 3, or 4 groups selected from group S2;

in the groups described above, each $R^{a1}$ and $R^{b1}$ are each independently H, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, deuterated $C_{1-6}$ alkyl, -$C_{1-4}$ alkyl-hydroxy, -$C_{1-4}$ alkyl-cyano,

-$C_{1-4}$ alkyl-$C_{1-6}$ haloalkyl, -$C_{1-4}$ alkyl-deuterated $C_{1-6}$ alkyl, -$C_{1-4}$ alkyl-$C_{1-6}$ alkoxy, -$C_{1-4}$ alkyl-$C_{1-6}$ haloalkoxy, -$C_{1-4}$ alkyl-deuterated $C_{1-6}$ alkoxy, $C_{3-6}$ monocyclic cycloalkyl, -$C_{1-4}$ alkyl-$C_{3-6}$ monocyclic cycloalkyl, -$C_{1-4}$ alkyl-O-$C_{3-6}$ monocyclic cycloalkyl, 3- to 6-membered monocyclic heterocyclyl, -$C_{1-4}$ alkyl-3- to 6-membered monocyclic heterocyclyl, -$C_{1-4}$ alkyl-O-3- to 6-membered monocyclic heterocyclyl, phenyl, -$C_{1-4}$ alkyl-phenyl, 5- or 6-membered monocyclic heteroaryl, -$C_{1-4}$ alkyl-5- or 6-membered monocyclic heteroaryl, 8- to 10-membered bicyclic heteroaryl, -$C_{1-4}$ alkyl-8- to 10-membered bicyclic heteroaryl, -$S(=O)_2$-$C_{1-6}$ alkyl, -$S(=O)_2$-$C_{3-6}$ monocyclic cycloalkyl, -$S(=O)_2$-3- to 6-membered monocyclic heterocyclyl, -$C_{1-4}$ alkyl-$S(=O)_2$-$C_{1-6}$ alkyl, -$C_{1-4}$ alkyl-$S(=O)_2$-$C_{3-6}$ monocyclic cycloalkyl, -$C_{1-4}$ alkyl-$S(=O)_2$-3- to 6-membered monocyclic heterocyclyl, -C(=O)-$C_{1-6}$ alkyl, -C(=O)-$C_{3-6}$ monocyclic cycloalkyl, or -C(=O)-3- to 6-membered monocyclic heterocyclyl; wherein, the $C_{3-6}$ monocyclic cycloalkyl, the 3- to 6-membered monocyclic heterocyclyl, the phenyl, the 5- or 6-membered monocyclic heteroaryl, or the 8- to 10-membered bicyclic heteroaryl is optionally substituted with 1 or 2 groups selected from the following group consisting of: halogen, hydroxy, carboxyl, nitro, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, deuterated $C_{1-6}$ alkyl, $C_{1-6}$ alkoxy, $C_{1-6}$ haloalkoxy, deuterated $C_{1-6}$ alkoxy, -$NH_2$, -$NHC_{1-6}$ alkyl, -$N(C_{1-6}$ alkyl$)_2$, -$C_{1-4}$ alkyl-P(=O)-($C_{1-6}$ alkyl$)_2$, and -P(=O)-($C_{1-6}$ alkyl$)_2$; or,

each $R^{a1}$ and $R^{b1}$, together with the nitrogen atom to which they are attached, form 3- to 20-membered heterocyclyl; wherein, each 3- to 20-membered heterocyclyl is independently and optionally substituted with 1 or 2 groups selected from the following group consisting of: halogen, hydroxy, carboxyl, nitro, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, deuterated $C_{1-6}$ alkyl, $C_{1-6}$ alkoxy, $C_{1-6}$ haloalkoxy, deuterated $C_{1-6}$ alkoxy, -$NH_2$, -$NHC_{1-6}$ alkyl, -$N(C_{1-6}$ alkyl$)_2$, -$C_{1-4}$ alkyl-P(=O)-($C_{1-6}$ alkyl$)_2$, and -P(=O)-($C_{1-6}$ alkyl$)_2$;

in the groups described above, each $R^{d1}$ is independently H, $C_{1-6}$ alkyl, or deuterated $C_{1-6}$ alkyl;

in the groups described above, each $R^{c1}$ is independently H, $C_{1-6}$ alkyl, -$C_{1-4}$ alkyl-hydroxy, -$C_{1-4}$ alkyl-$NR^{a1}R^{b1}$, $C_{1-6}$ haloalkyl, deuterated $C_{1-6}$ alkyl, $C_{1-6}$ alkoxy, $C_{1-6}$ haloalkoxy, deuterated $C_{1-6}$ alkoxy, -$C_{1-4}$ alkyl-$C_{1-6}$ haloalkyl, -$C_{1-4}$ alkyl-

deuterated $C_{1-6}$ alkyl, -$C_{1-4}$ alkyl-$C_{1-6}$ alkoxy, -$C_{1-4}$ alkyl-$C_{1-6}$ haloalkoxy, -$C_{1-4}$ alkyl-deuterated $C_{1-6}$ alkoxy, $C_{3-6}$ monocyclic cycloalkyl, -$C_{1-4}$ alkyl-$C_{3-6}$ monocyclic cycloalkyl, -$C_{1-4}$ alkyl-O-$C_{3-6}$ monocyclic cycloalkyl, 3- to 6-membered monocyclic heterocyclyl, -$C_{1-4}$ alkyl-3- to 6-membered monocyclic heterocyclyl, -$C_{1-4}$ alkyl-O-3- to 6-membered monocyclic heterocyclyl, phenyl, -$C_{1-4}$ alkyl-phenyl, 5- or 6-membered monocyclic heteroaryl, -$C_{1-4}$ alkyl-5- or 6-membered monocyclic heteroaryl, 8- to 10-membered bicyclic heteroaryl, or -$C_{1-4}$ alkyl-8- to 10-membered bicyclic heteroaryl; the $C_{3-6}$ monocyclic cycloalkyl, the 3- to 6-membered monocyclic heterocyclyl, the phenyl, the 5- or 6-membered monocyclic heteroaryl, or the 8- to 10-membered bicyclic heteroaryl is optionally substituted with 1 or 2 groups selected from the following group consisting of: halogen, hydroxy, carboxyl, nitro, $C_{1-6}$ alkyl, $C_{3-6}$ monocyclic cycloalkyl, $C_{1-6}$ haloalkyl, deuterated $C_{1-6}$ alkyl, $C_{1-6}$ alkoxy, $C_{1-6}$ haloalkoxy, deuterated $C_{1-6}$ alkoxy, -$NH_2$, -$NHC_{1-6}$ alkyl, -$N(C_{1-6}$ alkyl$)_2$, -$C_{1-4}$ alkyl-$P(=O)$-$(C_{1-6}$ alkyl$)_2$, and -$P(=O)$-$(C_{1-6}$ alkyl$)_2$;

in the groups described above, the groups of group S2 are each independently selected from the following group consisting of: deuterium, oxo (=O), thio (=S), $=CR^eR^f$, $=NR^e$, halogen, hydroxy, carboxyl, nitro, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, deuterated $C_{1-6}$ alkyl, $C_{1-6}$ alkoxy, $C_{1-6}$ haloalkoxy, deuterated $C_{1-6}$ alkoxy, -$NH_2$, -$NHC_{1-6}$ alkyl, -$N(C_{1-6}$ alkyl$)_2$, -$(C=O)$-$NHC_{1-6}$ alkyl, -$(C=O)$-$N(C_{1-6}$ alkyl$)_2$, -$C_{1-4}$ alkyl-$P(=O)$-$(C_{1-6}$ alkyl$)_2$, -$P(=O)$-$(C_{1-6}$ alkyl$)_2$, -$(C=O)C_{1-6}$ alkyl, -$SF_5$, and -$C_{1-4}$ alkyl-hydroxy;

in the groups described above, the -$C_{1-4}$ alkyl- is unsubstituted; or 1, 2, 3, or 4 hydrogen atoms on the -$C_{1-4}$ alkyl- are each independently substituted with a group selected from halogen, cyano, hydroxy, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, deuterated $C_{1-6}$ alkyl, -$CH_2$-hydroxy, -$CH_2$-cyano, phenyl, and $C_{3-6}$ monocyclic cycloalkyl; or 2 hydrogen atoms on the same carbon atom of the $C_{1-4}$ alkyl are both substituted with -$(CH_2)_j$- to form cycloalkyl, wherein j is 2, 3, 4, 5, or 6; or 2 hydrogen atoms on the same carbon atom of the $C_{1-4}$ alkyl are both substituted with $=CR^eR^f$;

in the groups described above, each $R^e$ is independently H, halogen, $C_{1-6}$ alkyl,

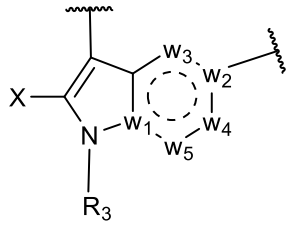
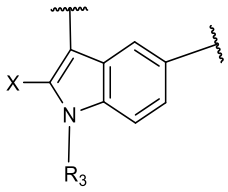
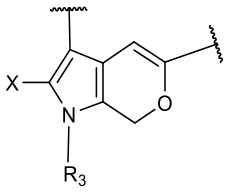
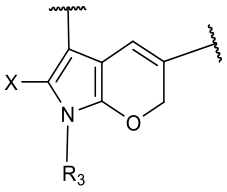
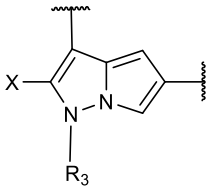
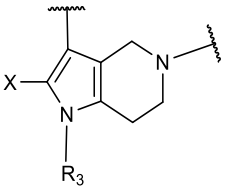
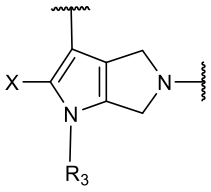
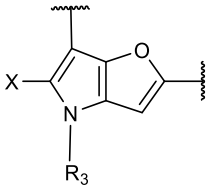
$C_{1-6}$ haloalkyl, or deuterated $C_{1-6}$ alkyl;

in the groups described above, each $R^f$ is independently H, halogen, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, or deuterated $C_{1-6}$ alkyl;

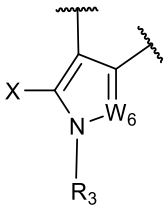
in the groups described above, one or more (e.g., 1, 2, 3, or 4) ring atoms of the 3- to 8-membered heterocyclyl, 3- to 10-membered heterocyclyl, or 3- to 8-membered monocyclic heterocyclyl are heteroatoms selected from nitrogen, oxygen, sulfur, and phosphorus; one or more (e.g., 1, 2, 3, or 4) ring atoms of the $C_{1-6}$ heteroalkyl are heteroatoms selected from nitrogen, oxygen, sulfur, and phosphorus; one or more (e.g., 1, 2, 3, 4, or 5) ring atoms of the 7- to 12-membered bicyclic heterocyclyl are heteroatoms selected from nitrogen, oxygen, sulfur, and phosphorus; one or more (e.g., 1, 2, 3, 4, or 5) ring atoms of the 3- to 20-membered heterocyclyl are heteroatoms selected from nitrogen, oxygen, sulfur, and phosphorus; one or more (e.g., 1, 2, 3, or 4) ring atoms of the 5- or 6-membered monocyclic heteroaryl are heteroatoms selected from nitrogen, oxygen, sulfur, and phosphorus; one or more (e.g., 1, 2, 3, 4, or 5) ring atoms of the 8- to 10-membered bicyclic heteroaryl are heteroatoms selected from nitrogen, oxygen, sulfur, and phosphorus; one or more (e.g., 1, 2, 3, or 4) ring atoms of the 3- to 6-membered monocyclic heterocyclyl are heteroatoms selected from nitrogen, oxygen, sulfur, and phosphorus; one or more (e.g., 1, 2, 3, 4, or 5) ring atoms of the 5- to 15-membered tricyclic heterocyclyl are heteroatoms selected from nitrogen, oxygen, sulfur, and phosphorus; one or more (e.g., 1, 2, 3, 4, or 5) ring atoms of the 6- to 12-membered heteroaryl-fused cycloalkyl are heteroatoms selected from nitrogen, oxygen, sulfur, and phosphorus; one or more (e.g., 1, 2, 3, 4, or 5) ring atoms of the 6- to 12-membered heteroaryl-fused heterocyclyl are heteroatoms selected from nitrogen, oxygen, sulfur, and phosphorus;

wherein, when the ring atom is a sulfur atom, the sulfur atom is optionally substituted with one or two groups selected from oxo and $=NR^e$; $R^e$ is as defined above;

wherein, when the ring atom is a phosphorus atom, the phosphorus atom is optionally substituted with one or two groups selected from oxo and $=NR^e$; $R^e$ is as defined above.

2. The compound, or the stable deuterated derivative thereof, or the stereoisomer thereof, or the pharmaceutically acceptable salt thereof, the solvate thereof, or the prodrug thereof according to claim 1, wherein,  is selected from the following group consisting of: , , , , , , and ; wherein, X is as defined above;

$R_3$ is hydrogen, substituted or unsubstituted $C_{1-6}$ alkyl, substituted or unsubstituted $C_{1-6}$ heteroalkyl, substituted or unsubstituted $C_{2-6}$ alkenyl, substituted or unsubstituted $C_{2-6}$ alkynyl, substituted or unsubstituted $C_{3-6}$ cycloalkyl, substituted or unsubstituted 3- to 8-membered heterocyclyl, substituted or unsubstituted $C_{6-10}$ aryl, substituted or unsubstituted 5- or 6-membered monocyclic heteroaryl, or substituted or unsubstituted 8- to 10-membered bicyclic heteroaryl; or



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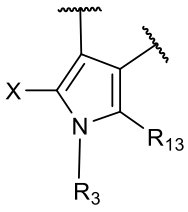

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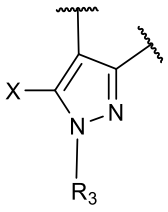
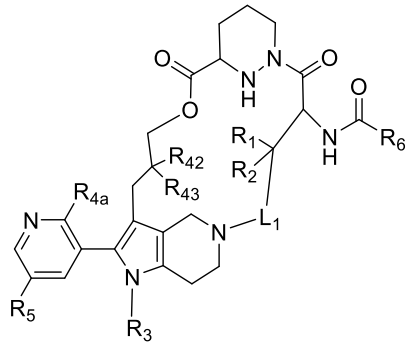


, wherein, X is as defined above;

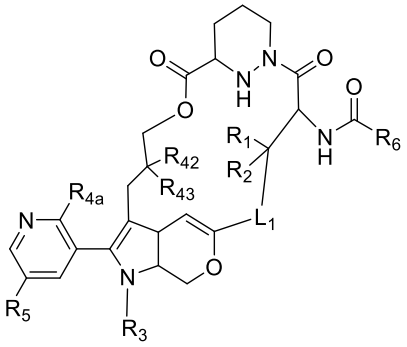
$R_3$ is hydrogen, substituted or unsubstituted $C_{1-6}$ alkyl, substituted or unsubstituted $C_{1-6}$ heteroalkyl, substituted or unsubstituted $C_{2-6}$ alkenyl, substituted or unsubstituted $C_{2-6}$ alkynyl, substituted or unsubstituted $C_{3-6}$ cycloalkyl, substituted or unsubstituted 3- to 8-membered heterocyclyl, substituted or unsubstituted $C_{6-10}$ aryl, substituted or unsubstituted 5- or 6-membered monocyclic heteroaryl, or substituted or unsubstituted 8- to 10-membered bicyclic heteroaryl; $R_{13}$ is hydrogen, halogen, substituted or unsubstituted $C_{1-6}$ alkoxy, or substituted or unsubstituted $C_{1-6}$ alkyl; or,

$R_{13}$ and $R_3$, together with the atom to which they are attached, form substituted or unsubstituted nitrogen-containing 3- to 8-membered monocyclic heterocyclyl or substituted or unsubstituted 5- or 6-membered monocyclic heteroaryl; in the nitrogen-containing 3- to 8-membered monocyclic heterocyclyl, one ring atom is a nitrogen atom, and optionally one or more (e.g., 1, 2, or 3) ring atoms are heteroatoms selected from nitrogen, oxygen, sulfur, and phosphorus.

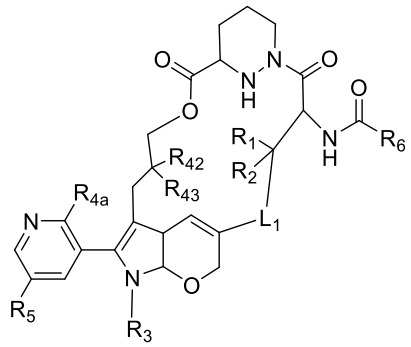
3. The compound, or the stable deuterated derivative thereof, or the stereoisomer thereof, or the pharmaceutically acceptable salt thereof, the solvate thereof, or the prodrug thereof according to claim 1, wherein, the compound of formula (I) is represented by formula (A1), formula (A2), formula (A3), formula (A4), formula (A5), formula (A6), formula (B1), formula (B2), formula (B3), or formula (B4):



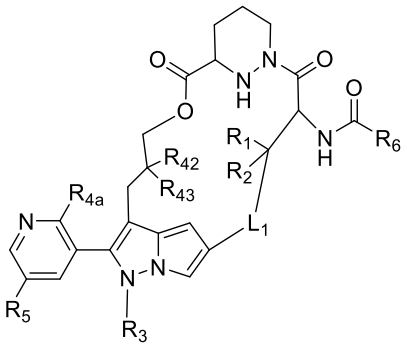
(A1)



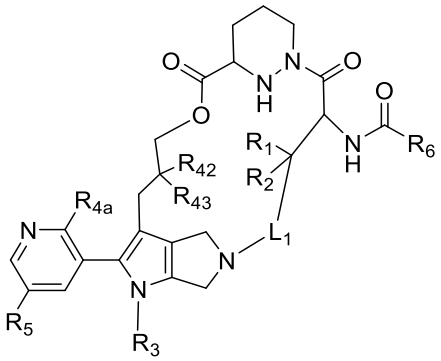
(A2)



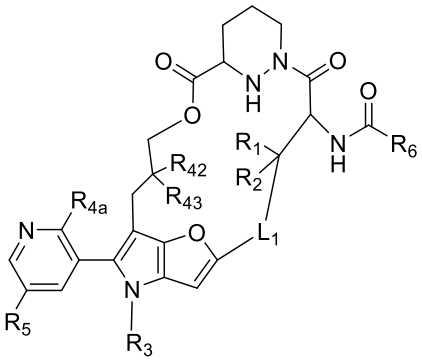
(A3)



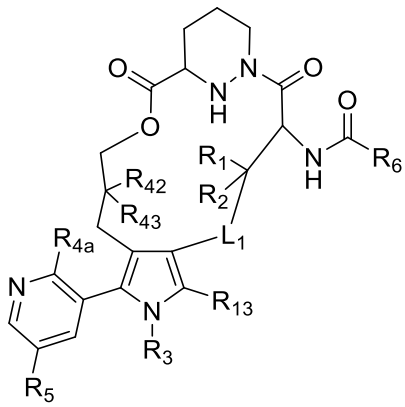
(A4)



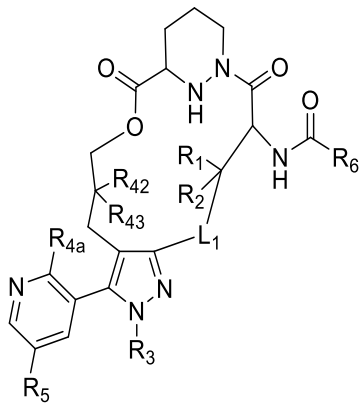
(A5)



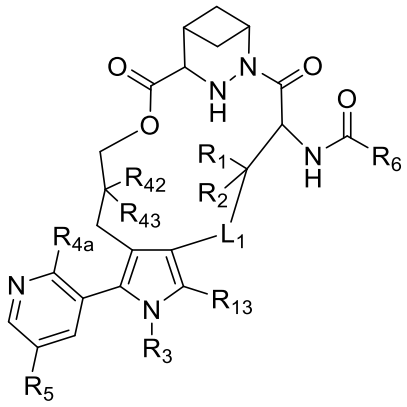
(A6)



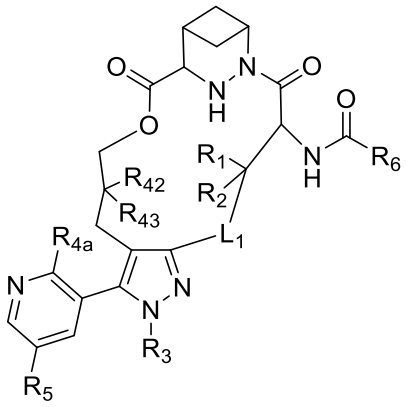
(B1)



(B2)



(B3)



(B4)

wherein,

$R_3$ is hydrogen, substituted or unsubstituted $C_{1-6}$ alkyl, substituted or unsubstituted $C_{1-6}$ heteroalkyl, substituted or unsubstituted $C_{2-6}$ alkenyl, substituted or unsubstituted $C_{2-6}$ alkynyl, substituted or unsubstituted $C_{3-6}$ cycloalkyl, substituted or unsubstituted 3- to 8-membered heterocyclyl, substituted or unsubstituted $C_{6-10}$ aryl, substituted or unsubstituted 5- or 6-membered monocyclic heteroaryl, or substituted or unsubstituted 8- to 10-membered bicyclic heteroaryl;

$R_{13}$ is hydrogen, halogen, substituted or unsubstituted $C_{1-6}$ alkyl, or substituted or unsubstituted $C_{1-6}$ alkoxy; or

$R_{13}$ and $R_3$, together with the atom to which they are attached, form substituted or unsubstituted nitrogen-containing 3- to 8-membered monocyclic heterocyclyl;

$R_{42}$ is hydrogen, halogen, or substituted or unsubstituted $C_{1-6}$ alkyl; $R_{43}$ is hydrogen, halogen, or substituted or unsubstituted $C_{1-6}$ alkyl; or

$R_{42}$ and $R_{43}$, together with the carbon atom to which they are attached, form substituted or unsubstituted $C_{3-6}$ cycloalkyl or substituted or unsubstituted 3- to 8-membered heterocyclyl;

$L_1$ is $-N(R_{00})C(=O)-$, $-N(R_{00})C(=O)-O-$, $-C_{1-4}$ alkyl-$N(R_{00})C(=O)-$, $-C(=O)N(R_{00})-C_{1-4}$ alkyl-, $-C_{1-4}$ alkyl-$N(R_{00})C(=S)-$, substituted or unsubstituted $C_{1-6}$ alkyl, -substituted or unsubstituted $C_{1-6}$ alkyl-O-, -substituted or unsubstituted $C_{2-6}$ alkenyl-O-substituted or unsubstituted $C_{3-6}$ cycloalkyl, substituted or unsubstituted 3- to 8-membered heterocyclyl, substituted or unsubstituted $C_{6-10}$ aryl, substituted or unsubstituted 5- or 6-membered monocyclic heteroaryl,

substituted or unsubstituted 8- to 10-membered bicyclic heteroaryl, -$L_2$-substituted or unsubstituted $C_{6-10}$ aryl, -$L_2$-substituted or unsubstituted 5- or 6-membered monocyclic heteroaryl, or -$L_2$-substituted or unsubstituted 3- to 8-membered heterocyclyl;

$L_2$ is -O-, -$C_{1-4}$ alkyl-, -$N(R_{00})$-, -C(=O)-, -$CR_{09}$=$CR_{10}$-, -$N(R_{00})$C(=O)-, or -$N(R_{00})$C(=S)-;

$R_{00}$ is hydrogen or $C_{1-6}$ alkyl;

$R_1$ is hydrogen, deuterium, halogen, hydroxy, $C_{1-6}$ alkyl, or substituted or unsubstituted $C_{1-6}$ heteroalkyl;

$R_2$ is hydrogen, deuterium, halogen, $C_{1-6}$ alkyl, or substituted or unsubstituted $C_{1-6}$ heteroalkyl;

$R_{4a}$ is substituted or unsubstituted $C_{1-6}$ alkyl, substituted or unsubstituted $C_{3-6}$ cycloalkyl, or substituted or unsubstituted 3- to 8-membered heterocyclyl;

$R_5$ is -$NR_{01}R_{02}$ or -$C_{2-4}$ alkynyl-$C_{1-4}$ alkyl-$NR_{01}R_{02}$;

$R_{01}$ and $R_{02}$ are each independently selected from hydrogen, substituted or unsubstituted $C_{1-6}$ alkyl, substituted or unsubstituted $C_{1-6}$ alkoxy, substituted or unsubstituted $C_{3-6}$ cycloalkyl, substituted or unsubstituted $C_{2-6}$ alkenyl, and substituted or unsubstituted $C_{2-6}$ alkynyl; or,

$R_{01}$ and $R_{02}$, together with the nitrogen atom to which they are attached, form substituted or unsubstituted 5- to 15-membered tricyclic heterocyclyl, substituted or unsubstituted 7- to 12-membered bicyclic heterocyclyl, or substituted or unsubstituted 3- to 8-membered monocyclic heterocyclyl;

$R_{09}$ is hydrogen, deuterium, halogen, or substituted or unsubstituted $C_{1-6}$ alkyl; the substitution refers to substitution with one or more (e.g., 1, 2, 3, or 4) groups selected from the following group consisting of: deuterium and halogen;

$R_{10}$ is hydrogen, deuterium, halogen, or substituted or unsubstituted $C_{1-6}$ alkyl; the substitution refers to substitution with one or more (e.g., 1, 2, 3, or 4) groups selected from the following group consisting of: deuterium and halogen;

$R_6$ is substituted or unsubstituted $C_{1-6}$ alkyl, substituted or unsubstituted $C_{1-6}$ heteroalkyl, substituted or unsubstituted $C_{3-6}$ cycloalkyl, substituted or unsubstituted 3- to 8-membered heterocyclyl, substituted or unsubstituted $C_{6-10}$

aryl, substituted or unsubstituted 5- or 6-membered monocyclic heteroaryl, or substituted or unsubstituted 8- to 10-membered bicyclic heteroaryl;

in the groups described above, the substitutions each independently refer to that the groups described above are each independently substituted with 1, 2, 3, 4, 5, or 6 groups selected from group S1; the groups of group S1 are each independently selected from the following group consisting of: $-SF_5$, deuterium, oxo (=O), thio (=S), $=CR^eR^f$, $=NR^e$, halogen, cyano, hydroxy, carboxyl, nitro, $C_{1-6}$ alkyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{1-6}$ alkoxy, $C_{3-20}$ cycloalkyl, 3- to 20-membered heterocyclyl, $C_{6-14}$ aryl, 5- or 6-membered monocyclic heteroaryl, 8- to 10-membered bicyclic heteroaryl, -O-$C_{3-20}$ cycloalkyl, -O-3- to 20-membered heterocyclyl, -O-$C_{6-14}$ aryl, -O-5- or 6-membered monocyclic heteroaryl, -O-8- to 10-membered bicyclic heteroaryl, -C≡C-$C_{3-20}$ cycloalkyl, -C≡C-3- to 20-membered heterocyclyl, -C≡C-$C_{6-14}$ aryl, -C≡C-5- or 6-membered monocyclic heteroaryl, -C≡C-8- to 10-membered bicyclic heteroaryl, -C≡C-$C_{1-4}$ alkyl-$C_{3-20}$ cycloalkyl, -C≡C-$C_{1-4}$ alkyl-3- to 20-membered heterocyclyl, -C≡C-$C_{1-4}$ alkyl-$C_{6-14}$ aryl, -C≡C-$C_{1-4}$ alkyl-5- or 6-membered monocyclic heteroaryl, -C≡C-$C_{1-4}$ alkyl-8- to 10-membered bicyclic heteroaryl, -$C_{1-4}$ alkyl-hydroxy, -$C_{1-4}$ alkyl-cyano, -$C_{1-4}$ alkyl-$C_{1-6}$ alkyl, -$C_{1-4}$ alkyl-$C_{1-6}$ alkoxy, -$C_{1-4}$ alkyl-$C_{3-20}$ cycloalkyl, -$C_{1-4}$ alkyl-O-$C_{3-20}$ cycloalkyl, -$C_{1-4}$ alkyl-3- to 20-membered heterocyclyl, -$C_{1-4}$ alkyl-O-3- to 20-membered heterocyclyl, -$C_{1-4}$ alkyl-$C_{6-14}$ aryl, -$C_{1-4}$ alkyl-O-$C_{6-14}$ aryl, -$C_{1-4}$ alkyl-5- or 6-membered monocyclic heteroaryl, -$C_{1-4}$ alkyl-O-5- or 6-membered monocyclic heteroaryl, -$C_{1-4}$ alkyl-8- to 10-membered bicyclic heteroaryl, -$C_{1-4}$ alkyl-O-8- to 10-membered bicyclic heteroaryl, -O-$C_{1-4}$ alkyl-hydroxy, -O-$C_{1-4}$ alkyl-cyano, -O-$C_{1-4}$ alkyl-$C_{1-6}$ alkyl, -O-$C_{1-4}$ alkyl-$C_{1-6}$ alkoxy, -O-$C_{1-4}$ alkyl-$C_{3-20}$ cycloalkyl, -O-$C_{1-4}$ alkyl-O-$C_{3-20}$ cycloalkyl, -O-$C_{1-4}$ alkyl-3- to 20-membered heterocyclyl, -O-$C_{1-4}$ alkyl-O-3- to 20-membered heterocyclyl, -O-$C_{1-4}$ alkyl-$C_{6-14}$ aryl, -O-$C_{1-4}$ alkyl-O-$C_{6-14}$ aryl, -O-$C_{1-4}$ alkyl-5- or 6-membered monocyclic heteroaryl, -O-$C_{1-4}$ alkyl-O-5- or 6-membered monocyclic heteroaryl, -O-$C_{1-4}$ alkyl-8- to 10-membered bicyclic heteroaryl, -O-$C_{1-4}$ alkyl-O-8- to 10-membered bicyclic heteroaryl, -$S(=O)_2$-$C_{1-6}$ alkyl, -$S(=O)_2$-$C_{3-20}$ cycloalkyl, -$S(=O)_2$-3- to 20-membered heterocyclyl, -C(=O)O-$C_{1-6}$ alkyl, -C(=O)O-$C_{3-20}$

cycloalkyl, -C(=O)-$C_{1-6}$ alkyl, -C(=O)-$C_{3-20}$ cycloalkyl, -C(=O)-$C_{6-14}$ aryl, -$NR^{a1}R^{b1}$, -C(=O)-$NR^{a1}R^{b1}$, -C(=O)-$NR^{d1}$-$C_{1-4}$ alkyl-$R^{c1}$, -$OR^{c1}$, -$C_{1-4}$ alkyl-$S(=O)_2$-$C_{1-6}$ alkyl, -$C_{1-4}$ alkyl-$S(=O)_2$-$C_{3-20}$ cycloalkyl, -$C_{1-4}$ alkyl-$S(=O)_2$-3- to 20-membered heterocyclyl, -$C_{1-4}$ alkyl-C(=O)O-$C_{1-6}$ alkyl, -$C_{1-4}$ alkyl-C(=O)O-$C_{3-20}$ cycloalkyl, -$C_{1-4}$ alkyl-C(=O)-$C_{1-6}$ alkyl, -$C_{1-4}$ alkyl-C(=O)-$C_{3-20}$ cycloalkyl, -$C_{1-4}$ alkyl-C(=O)-$C_{6-14}$ aryl, -C(=O)-5- or 6-membered monocyclic heteroaryl, -C(=O)-8- to 10-membered bicyclic heteroaryl, -C(=O)-$C_{1-6}$ alkyl-$C_{3-20}$ cycloalkyl, -C(=O)-$C_{1-6}$ alkyl-3- to 20-membered heterocyclyl, -C(=O)-$C_{1-6}$ alkyl-$C_{6-14}$ aryl, -C(=O)-$C_{1-6}$ alkyl-5- or 6-membered monocyclic heteroaryl, -C(=O)-$C_{1-6}$ alkyl-8- to 10-membered bicyclic heteroaryl, -$C_{1-4}$ alkyl-$NR^{a1}R^{b1}$, -$C_{1-4}$ alkyl-C(=O)-$NR^{a1}R^{b1}$, -C≡C-C(=O)-$NR^{a1}R^{b1}$, -C≡C-$C_{1-4}$ alkyl-C(=O)-$NR^{a1}R^{b1}$, -$C_{1-4}$ alkyl-$OR^{c1}$, -$C_{1-4}$ alkyl-P(=O)-($C_{1-6}$ alkyl)$_2$, -P(=O)-($C_{1-6}$ alkyl)$_2$, -$C_{1-4}$ alkyl-$NR^{d1}$-C(=O)-$R^{c1}$, -$C_{1-4}$ alkyl-$NR^{d1}$-C(=O)-$NR^{a1}R^{b1}$, -$C_{1-4}$ alkyl-$NR^{d1}$-$S(=O)_2$-$R^{c1}$, -$C_{1-4}$ alkyl-$S(=O)_2$-$NR^{a1}R^{b1}$, -$C_{1-4}$ alkyl-$NR^{d1}$-$S(=O)_2$-$NR^{a1}R^{b1}$, -$NR^{d1}$-C(=O)-$R^{c1}$, -$NR^{d1}$-C(=O)-$C_{1-4}$ alkyl-$R^{c1}$, -$NR^{d1}$-C(=O)-$NR^{a1}R^{b1}$, -$NR^{d1}$-$S(=O)_2$-$R^{c1}$, -$S(=O)_2$-$NR^{a1}R^{b1}$, -$NR^{d1}$-$S(=O)_2$-$NR^{a1}R^{b1}$, and -P(=O)-($C_{1-6}$ alkyl)$_2$; wherein, the $C_{1-6}$ alkyl, the $C_{1-6}$ alkoxy, the $C_{2-6}$ alkenyl, and the $C_{2-6}$ alkynyl are each independently and optionally substituted with 1, 2, or 3 groups selected from halogen, deuterium, cyano, and hydroxy; the $C_{3-20}$ cycloalkyl, the 3- to 20-membered heterocyclyl, the $C_{6-14}$ aryl, the 5- or 6-membered monocyclic heteroaryl, and the 8- to 10-membered bicyclic heteroaryl are each independently and optionally substituted with 1, 2, 3, or 4 groups selected from group S2;

in the groups described above, each $R^{a1}$ and $R^{b1}$ are each independently H, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, deuterated $C_{1-6}$ alkyl, -$C_{1-4}$ alkyl-hydroxy, -$C_{1-4}$ alkyl-cyano, -$C_{1-4}$ alkyl-$C_{1-6}$ haloalkyl, -$C_{1-4}$ alkyl-deuterated $C_{1-6}$ alkyl, -$C_{1-4}$ alkyl-$C_{1-6}$ alkoxy, -$C_{1-4}$ alkyl-$C_{1-6}$ haloalkoxy, -$C_{1-4}$ alkyl-deuterated $C_{1-6}$ alkoxy, $C_{3-6}$ monocyclic cycloalkyl, -$C_{1-4}$ alkyl-$C_{3-6}$ monocyclic cycloalkyl, -$C_{1-4}$ alkyl-O-$C_{3-6}$ monocyclic cycloalkyl, 3- to 6-membered monocyclic heterocyclyl, -$C_{1-4}$ alkyl-3- to 6-membered monocyclic heterocyclyl, -$C_{1-4}$ alkyl-O-3- to 6-membered monocyclic heterocyclyl, phenyl, -$C_{1-4}$ alkyl-phenyl, 5- or 6-membered monocyclic heteroaryl, -$C_{1-4}$ alkyl-5- or 6-membered monocyclic heteroaryl, 8- to 10-membered bicyclic

heteroaryl, -$C_{1-4}$ alkyl-8- to 10-membered bicyclic heteroaryl, -$S(=O)_2$-$C_{1-6}$ alkyl, -$S(=O)_2$-$C_{3-6}$ monocyclic cycloalkyl, -$S(=O)_2$-3- to 6-membered monocyclic heterocyclyl, -$C_{1-4}$ alkyl-$S(=O)_2$-$C_{1-6}$ alkyl, -$C_{1-4}$ alkyl-$S(=O)_2$-$C_{3-6}$ monocyclic cycloalkyl, -$C_{1-4}$ alkyl-$S(=O)_2$-3- to 6-membered monocyclic heterocyclyl, -C(=O)-$C_{1-6}$ alkyl, -C(=O)-$C_{3-6}$ monocyclic cycloalkyl, or -C(=O)-3- to 6-membered monocyclic heterocyclyl; wherein the $C_{3-6}$ monocyclic cycloalkyl, the 3- to 6-membered monocyclic heterocyclyl, the phenyl, the 5- or 6-membered monocyclic heteroaryl, or the 8- to 10-membered bicyclic heteroaryl is optionally substituted with 1 or 2 groups selected from the following group consisting of: halogen, hydroxy, carboxyl, nitro, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, deuterated $C_{1-6}$ alkyl, $C_{1-6}$ alkoxy, $C_{1-6}$ haloalkoxy, deuterated $C_{1-6}$ alkoxy, -$NH_2$, -NH$C_{1-6}$ alkyl, -N($C_{1-6}$ alkyl)$_2$, -$C_{1-4}$ alkyl-P(=O)-($C_{1-6}$ alkyl)$_2$, and -P(=O)-($C_{1-6}$ alkyl)$_2$; or

each $R^{a1}$ and $R^{b1}$, together with the nitrogen atom to which they are attached, form 3- to 20-membered heterocyclyl; wherein, each 3- to 20-membered heterocyclyl is independently and optionally substituted with 1 or 2 groups selected from the following group consisting of: halogen, hydroxy, carboxyl, nitro, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, deuterated $C_{1-6}$ alkyl, $C_{1-6}$ alkoxy, $C_{1-6}$ haloalkoxy, deuterated $C_{1-6}$ alkoxy, -$NH_2$, -NH$C_{1-6}$ alkyl, -N($C_{1-6}$ alkyl)$_2$, -$C_{1-4}$ alkyl-P(=O)-($C_{1-6}$ alkyl)$_2$, and -P(=O)-($C_{1-6}$ alkyl)$_2$;

in the groups described above, each $R^{d1}$ is independently H, $C_{1-6}$ alkyl, or deuterated $C_{1-6}$ alkyl;

in the groups described above, each $R^{c1}$ is independently H, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, deuterated $C_{1-6}$ alkyl, $C_{1-6}$ alkoxy, $C_{1-6}$ haloalkoxy, deuterated $C_{1-6}$ alkoxy, -$C_{1-4}$ alkyl-$C_{1-6}$ haloalkyl, -$C_{1-4}$ alkyl-deuterated $C_{1-6}$ alkyl, -$C_{1-4}$ alkyl-$C_{1-6}$ alkoxy, -$C_{1-4}$ alkyl-$C_{1-6}$ haloalkoxy, -$C_{1-4}$ alkyl-deuterated $C_{1-6}$ alkoxy, $C_{3-6}$ monocyclic cycloalkyl, -$C_{1-4}$ alkyl-$C_{3-6}$ monocyclic cycloalkyl, -$C_{1-4}$ alkyl-O-$C_{3-6}$ monocyclic cycloalkyl, 3- to 6-membered monocyclic heterocyclyl, -$C_{1-4}$ alkyl-3- to 6-membered monocyclic heterocyclyl, -$C_{1-4}$ alkyl-O-3- to 6-membered monocyclic heterocyclyl, phenyl, -$C_{1-4}$ alkyl-phenyl, 5- or 6-membered monocyclic heteroaryl, -$C_{1-4}$ alkyl-5- or 6-membered monocyclic heteroaryl, 8- to 10-membered bicyclic heteroaryl, or -$C_{1-4}$ alkyl-8- to 10-membered bicyclic

heteroaryl; the $C_{3-6}$ monocyclic cycloalkyl, the 3- to 6-membered monocyclic heterocyclyl, the phenyl, the 5- or 6-membered monocyclic heteroaryl, or the 8- to 10-membered bicyclic heteroaryl is optionally substituted with 1 or 2 groups selected from the following group consisting of: halogen, hydroxy, carboxyl, nitro, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, deuterated $C_{1-6}$ alkyl, $C_{1-6}$ alkoxy, $C_{1-6}$ haloalkoxy, deuterated $C_{1-6}$ alkoxy, $-NH_2$, $-NHC_{1-6}$ alkyl, $-N(C_{1-6}$ alkyl$)_2$, $-C_{1-4}$ alkyl-P(=O)-($C_{1-6}$ alkyl$)_2$, and -P(=O)-($C_{1-6}$ alkyl$)_2$;

in the groups described above, the groups of group S2 are each independently selected from the following group consisting of: deuterium, oxo (=O), thio (=S), $=CR^eR^f$, $=NR^e$, halogen, hydroxy, carboxyl, nitro, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, deuterated $C_{1-6}$ alkyl, $C_{1-6}$ alkoxy, $C_{1-6}$ haloalkoxy, deuterated $C_{1-6}$ alkoxy, $-NH_2$, $-NHC_{1-6}$ alkyl, $-N(C_{1-6}$ alkyl$)_2$, -(C=O)-$NHC_{1-6}$ alkyl, -(C=O)-$N(C_{1-6}$ alkyl$)_2$, $-C_{1-4}$ alkyl-P(=O)-($C_{1-6}$ alkyl$)_2$, -P(=O)-($C_{1-6}$ alkyl$)_2$, -(C=O)$C_{1-6}$ alkyl, and $SF_5$;

in the groups described above, the $-C_{1-4}$ alkyl- is unsubstituted; or 1, 2, 3, or 4 hydrogen atoms on the $-C_{1-4}$ alkyl- are each independently substituted with a group selected from halogen, cyano, hydroxy, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, deuterated $C_{1-6}$ alkyl, $-CH_2$-hydroxy, $-CH_2$-cyano, and phenyl; or 2 hydrogen atoms on the same carbon atom of the $C_{1-4}$ alkyl are both substituted with $-(CH_2)_j-$ to form cycloalkyl, wherein j is 2, 3, 4, 5, or 6; or 2 hydrogen atoms on the same carbon atom of the $C_{1-4}$ alkyl are both substituted with $=CR^eR^f$;

in the groups described above, each $R^e$ is independently H, halogen, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, or deuterated $C_{1-6}$ alkyl;

in the groups described above, each $R^f$ is independently H, halogen, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, or deuterated $C_{1-6}$ alkyl;

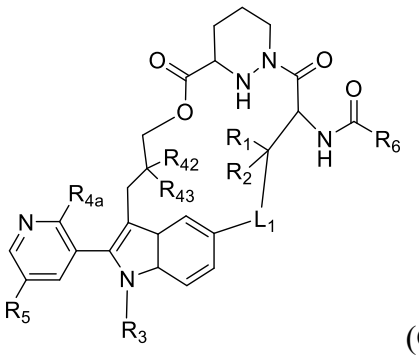
in the groups described above, one or more (e.g., 1, 2, 3, or 4) ring atoms of the 3- to 8-membered heterocyclyl, 3- to 10-membered heterocyclyl, or 3- to 8-membered monocyclic heterocyclyl are heteroatoms selected from nitrogen, oxygen, sulfur, and phosphorus; one or more (e.g., 1, 2, 3, or 4) ring atoms of the $C_{1-6}$ heteroalkyl are heteroatoms selected from nitrogen, oxygen, sulfur, and phosphorus; one or more (e.g., 1, 2, 3, 4, or 5) ring atoms of the 7- to 12-membered bicyclic heterocyclyl are heteroatoms selected from nitrogen, oxygen, sulfur, and

phosphorus; one or more (e.g., 1, 2, 3, 4, or 5) ring atoms of the 3- to 20-membered heterocyclyl are heteroatoms selected from nitrogen, oxygen, sulfur, and phosphorus; one or more (e.g., 1, 2, 3, or 4) ring atoms of the 5- or 6-membered monocyclic heteroaryl are heteroatoms selected from nitrogen, oxygen, sulfur, and phosphorus; one or more (e.g., 1, 2, 3, 4, or 5) ring atoms of the 8- to 10-membered bicyclic heteroaryl are heteroatoms selected from nitrogen, oxygen, sulfur, and phosphorus; one or more (e.g., 1, 2, 3, or 4) ring atoms of the 3- to 6-membered monocyclic heterocyclyl are heteroatoms selected from nitrogen, oxygen, sulfur, and phosphorus; one or more (e.g., 1, 2, 3, 4, or 5) ring atoms of the 5- to 15-membered tricyclic heterocyclyl are heteroatoms selected from nitrogen, oxygen, sulfur, and phosphorus;

wherein, when the ring atom is a sulfur atom, the sulfur atom is optionally substituted with one or two groups selected from oxo and $=NR^e$; $R^e$ is as defined above;

wherein, when the ring atom is a phosphorus atom, the phosphorus atom is optionally substituted with one or two groups selected from oxo and $=NR^e$; $R^e$ is as defined above.

4. The compound, or the stable deuterated derivative thereof, or the stereoisomer thereof, or the pharmaceutically acceptable salt thereof, the solvate thereof, or the prodrug thereof according to claim 1, wherein, the compound of formula (I) is represented by formula (C1):



(C1)

$R_{42}$ is hydrogen, halogen, or substituted or unsubstituted $C_{1-6}$ alkyl; $R_{43}$ is hydrogen, halogen, or substituted or unsubstituted $C_{1-6}$ alkyl; or

$R_{42}$ and $R_{43}$, together with the carbon atom to which they are attached, form substituted or unsubstituted $C_{3-6}$ cycloalkyl or substituted or unsubstituted 3- to 8-membered heterocyclyl;

$L_1$ is $-N(R_{00})C(=O)-O-$, $-C_{1-4}$ alkyl-$N(R_{00})C(=O)-$, $-C(=O)N(R_{00})-C_{1-4}$ alkyl-, $-C_{1-4}$ alkyl-$N(R_{00})C(=S)-$, -substituted or unsubstituted $C_{1-6}$ alkyl-O-, or -substituted or unsubstituted $C_{2-6}$ alkenyl-O-;

$R_{00}$ is hydrogen or $C_{1-6}$ alkyl;

$R_1$ is hydrogen, deuterium, halogen, hydroxy, $C_{1-6}$ alkyl, or substituted or unsubstituted $C_{1-6}$ heteroalkyl;

$R_2$ is hydrogen, deuterium, halogen, $C_{1-6}$ alkyl, or substituted or unsubstituted $C_{1-6}$ heteroalkyl;

$R_3$ is hydrogen, substituted or unsubstituted $C_{1-6}$ alkyl, substituted or unsubstituted $C_{1-6}$ heteroalkyl, substituted or unsubstituted $C_{2-6}$ alkenyl, substituted or unsubstituted $C_{2-6}$ alkynyl, substituted or unsubstituted $C_{3-6}$ cycloalkyl, substituted or unsubstituted 3- to 8-membered heterocyclyl, substituted or unsubstituted $C_{6-10}$ aryl, substituted or unsubstituted 5- or 6-membered monocyclic heteroaryl, or substituted or unsubstituted 8- to 10-membered bicyclic heteroaryl;

$R_{4a}$ is substituted or unsubstituted $C_{1-6}$ alkyl, substituted or unsubstituted $C_{3-6}$ cycloalkyl, or substituted or unsubstituted 3- to 8-membered heterocyclyl;

$R_5$ is $-NR_{01}R_{02}$ or $-C_{2-4}$ alkynyl-$C_{1-4}$ alkyl-$NR_{01}R_{02}$;

$R_{01}$ and $R_{02}$ are each independently selected from hydrogen, substituted or unsubstituted $C_{1-6}$ alkyl, substituted or unsubstituted $C_{1-6}$ alkoxy, substituted or unsubstituted $C_{3-6}$ cycloalkyl, substituted or unsubstituted $C_{2-6}$ alkenyl, and substituted or unsubstituted $C_{2-6}$ alkynyl; or,

$R_{01}$ and $R_{02}$, together with the nitrogen atom to which they are attached, form substituted or unsubstituted 5- to 15-membered tricyclic heterocyclyl, substituted or unsubstituted 7- to 12-membered bicyclic heterocyclyl, or substituted or unsubstituted 3- to 8-membered monocyclic heterocyclyl;

$R_6$ is substituted or unsubstituted $C_{1-6}$ alkyl, substituted or unsubstituted $C_{1-6}$ heteroalkyl, substituted or unsubstituted $C_{3-6}$ cycloalkyl, substituted or

unsubstituted 3- to 8-membered heterocyclyl, substituted or unsubstituted $C_{6-10}$ aryl, substituted or unsubstituted 5- or 6-membered monocyclic heteroaryl, or substituted or unsubstituted 8- to 10-membered bicyclic heteroaryl;

in the groups described above, the substitutions each independently refer to that the groups described above are each independently substituted with 1, 2, 3, 4, 5, or 6 groups selected from group S1; the groups of group S1 are each independently selected from the following group consisting of: $-SF_5$, deuterium, oxo (=O), thio (=S), $=CR^eR^f$, $=NR^e$, halogen, cyano, hydroxy, carboxyl, nitro, $C_{1-6}$ alkyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{1-6}$ alkoxy, $C_{3-20}$ cycloalkyl, 3- to 20-membered heterocyclyl, $C_{6-14}$ aryl, 5- or 6-membered monocyclic heteroaryl, 8- to 10-membered bicyclic heteroaryl, -O-$C_{3-20}$ cycloalkyl, -O-3- to 20-membered heterocyclyl, -O-$C_{6-14}$ aryl, -O-5- or 6-membered monocyclic heteroaryl, -O-8- to 10-membered bicyclic heteroaryl, -C≡C-$C_{3-20}$ cycloalkyl, -C≡C-3- to 20-membered heterocyclyl, -C≡C-$C_{6-14}$ aryl, -C≡C-5- or 6-membered monocyclic heteroaryl, -C≡C-8- to 10-membered bicyclic heteroaryl, -C≡C-$C_{1-4}$ alkyl-$C_{3-20}$ cycloalkyl, -C≡C-$C_{1-4}$ alkyl-3- to 20-membered heterocyclyl, -C≡C-$C_{1-4}$ alkyl-$C_{6-14}$ aryl, -C≡C-$C_{1-4}$ alkyl-5- or 6-membered monocyclic heteroaryl, -C≡C-$C_{1-4}$ alkyl-8- to 10-membered bicyclic heteroaryl, -$C_{1-4}$ alkyl-hydroxy, -$C_{1-4}$ alkyl-cyano, -$C_{1-4}$ alkyl-$C_{1-6}$ alkyl, -$C_{1-4}$ alkyl-$C_{1-6}$ alkoxy, -$C_{1-4}$ alkyl-$C_{3-20}$ cycloalkyl, -$C_{1-4}$ alkyl-O-$C_{3-20}$ cycloalkyl, -$C_{1-4}$ alkyl-3- to 20-membered heterocyclyl, -$C_{1-4}$ alkyl-O-3- to 20-membered heterocyclyl, -$C_{1-4}$ alkyl-$C_{6-14}$ aryl, -$C_{1-4}$ alkyl-O-$C_{6-14}$ aryl, -$C_{1-4}$ alkyl-5- or 6-membered monocyclic heteroaryl, -$C_{1-4}$ alkyl-O-5- or 6-membered monocyclic heteroaryl, -$C_{1-4}$ alkyl-8- to 10-membered bicyclic heteroaryl, -$C_{1-4}$ alkyl-O-8- to 10-membered bicyclic heteroaryl, -O-$C_{1-4}$ alkyl-hydroxy, -O-$C_{1-4}$ alkyl-cyano, -O-$C_{1-4}$ alkyl-$C_{1-6}$ alkyl, -O-$C_{1-4}$ alkyl-$C_{1-6}$ alkoxy, -O-$C_{1-4}$ alkyl-$C_{3-20}$ cycloalkyl, -O-$C_{1-4}$ alkyl-O-$C_{3-20}$ cycloalkyl, -O-$C_{1-4}$ alkyl-3- to 20-membered heterocyclyl, -O-$C_{1-4}$ alkyl-O-3- to 20-membered heterocyclyl, -O-$C_{1-4}$ alkyl-$C_{6-14}$ aryl, -O-$C_{1-4}$ alkyl-O-$C_{6-14}$ aryl, -O-$C_{1-4}$ alkyl-5- or 6-membered monocyclic heteroaryl, -O-$C_{1-4}$ alkyl-O-5- or 6-membered monocyclic heteroaryl, -O-$C_{1-4}$ alkyl-8- to 10-membered bicyclic heteroaryl, -O-$C_{1-4}$ alkyl-O-8- to 10-membered bicyclic heteroaryl, -$S(=O)_2$-$C_{1-6}$ alkyl, -$S(=O)_2$-$C_{3-20}$ cycloalkyl, -

$S(=O)_2$-3- to 20-membered heterocyclyl, -C(=O)O-$C_{1-6}$ alkyl, -C(=O)O-$C_{3-20}$ cycloalkyl, -C(=O)-$C_{1-6}$ alkyl, -C(=O)-$C_{3-20}$ cycloalkyl, -C(=O)-$C_{6-14}$ aryl, -$NR^{a1}R^{b1}$, -C(=O)-$NR^{a1}R^{b1}$, -C(=O)-$NR^{d1}$-$C_{1-4}$ alkyl-$R^{c1}$, -$OR^{c1}$, -$C_{1-4}$ alkyl-$S(=O)_2$-$C_{1-6}$ alkyl, -$C_{1-4}$ alkyl-$S(=O)_2$-$C_{3-20}$ cycloalkyl, -$C_{1-4}$ alkyl-$S(=O)_2$-3- to 20-membered heterocyclyl, -$C_{1-4}$ alkyl-C(=O)O-$C_{1-6}$ alkyl, -$C_{1-4}$ alkyl-C(=O)O-$C_{3-20}$ cycloalkyl, -$C_{1-4}$ alkyl-C(=O)-$C_{1-6}$ alkyl, -$C_{1-4}$ alkyl-C(=O)-$C_{3-20}$ cycloalkyl, -$C_{1-4}$ alkyl-C(=O)-$C_{6-14}$ aryl, -C(=O)-5- or 6-membered monocyclic heteroaryl, -C(=O)-8- to 10-membered bicyclic heteroaryl, -C(=O)-$C_{1-6}$ alkyl-$C_{3-20}$ cycloalkyl, -C(=O)-$C_{1-6}$ alkyl-3- to 20-membered heterocyclyl, -C(=O)-$C_{1-6}$ alkyl-$C_{6-14}$ aryl, -C(=O)-$C_{1-6}$ alkyl-5- or 6-membered monocyclic heteroaryl, -C(=O)-$C_{1-6}$ alkyl-8- to 10-membered bicyclic heteroaryl, -$C_{1-4}$ alkyl-$NR^{a1}R^{b1}$, -$C_{1-4}$ alkyl-C(=O)-$NR^{a1}R^{b1}$, -C≡C-C(=O)-$NR^{a1}R^{b1}$, -C≡C-$C_{1-4}$ alkyl-C(=O)-$NR^{a1}R^{b1}$, -$C_{1-4}$ alkyl-$OR^{c1}$, -$C_{1-4}$ alkyl-P(=O)-($C_{1-6}$ alkyl)$_2$, -P(=O)-($C_{1-6}$ alkyl)$_2$, -$C_{1-4}$ alkyl-$NR^{d1}$-C(=O)-$R^{c1}$, -$C_{1-4}$ alkyl-$NR^{d1}$-C(=O)-$NR^{a1}R^{b1}$, -$C_{1-4}$ alkyl-$NR^{d1}$-$S(=O)_2$-$R^{c1}$, -$C_{1-4}$ alkyl-$S(=O)_2$-$NR^{a1}R^{b1}$, -$C_{1-4}$ alkyl-$NR^{d1}$-$S(=O)_2$-$NR^{a1}R^{b1}$, -$NR^{d1}$-C(=O)-$R^{c1}$, -$NR^{d1}$-C(=O)-$C_{1-4}$ alkyl-$R^{c1}$, -$NR^{d1}$-C(=O)-$NR^{a1}R^{b1}$, -$NR^{d1}$-$S(=O)_2$-$R^{c1}$, -$S(=O)_2$-$NR^{a1}R^{b1}$, -$NR^{d1}$-$S(=O)_2$-$NR^{a1}R^{b1}$, and -P(=O)-($C_{1-6}$ alkyl)$_2$; wherein, the $C_{1-6}$ alkyl, the $C_{1-6}$ alkoxy, the $C_{2-6}$ alkenyl, and the $C_{2-6}$ alkynyl are each independently and optionally substituted with 1, 2, or 3 groups selected from halogen, deuterium, cyano, and hydroxy; the $C_{3-20}$ cycloalkyl, the 3- to 20-membered heterocyclyl, the $C_{6-14}$ aryl, the 5- or 6-membered monocyclic heteroaryl, and the 8- to 10-membered bicyclic heteroaryl are each independently and optionally substituted with 1, 2, 3, or 4 groups selected from group S2;

in the groups described above, each $R^{a1}$ and $R^{b1}$ are each independently H, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, deuterated $C_{1-6}$ alkyl, -$C_{1-4}$ alkyl-hydroxy, -$C_{1-4}$ alkyl-cyano, -$C_{1-4}$ alkyl-$C_{1-6}$ haloalkyl, -$C_{1-4}$ alkyl-deuterated $C_{1-6}$ alkyl, -$C_{1-4}$ alkyl-$C_{1-6}$ alkoxy, -$C_{1-4}$ alkyl-$C_{1-6}$ haloalkoxy, -$C_{1-4}$ alkyl-deuterated $C_{1-6}$ alkoxy, $C_{3-6}$ monocyclic cycloalkyl, -$C_{1-4}$ alkyl-$C_{3-6}$ monocyclic cycloalkyl, -$C_{1-4}$ alkyl-O-$C_{3-6}$ monocyclic cycloalkyl, 3- to 6-membered monocyclic heterocyclyl, -$C_{1-4}$ alkyl-3- to 6-membered monocyclic heterocyclyl, -$C_{1-4}$ alkyl-O-3- to 6-membered monocyclic heterocyclyl, phenyl, -$C_{1-4}$ alkyl-phenyl, 5- or 6-membered monocyclic heteroaryl,

-$C_{1-4}$ alkyl-5- or 6-membered monocyclic heteroaryl, 8- to 10-membered bicyclic heteroaryl, -$C_{1-4}$ alkyl-8- to 10-membered bicyclic heteroaryl, -$S(=O)_2$-$C_{1-6}$ alkyl, -$S(=O)_2$-$C_{3-6}$ monocyclic cycloalkyl, -$S(=O)_2$-3- to 6-membered monocyclic heterocyclyl, -$C_{1-4}$ alkyl-$S(=O)_2$-$C_{1-6}$ alkyl, -$C_{1-4}$ alkyl-$S(=O)_2$-$C_{3-6}$ monocyclic cycloalkyl, -$C_{1-4}$ alkyl-$S(=O)_2$-3- to 6-membered monocyclic heterocyclyl, -C(=O)-$C_{1-6}$ alkyl, -C(=O)-$C_{3-6}$ monocyclic cycloalkyl, or -C(=O)-3- to 6-membered monocyclic heterocyclyl; wherein, the $C_{3-6}$ monocyclic cycloalkyl, the 3- to 6-membered monocyclic heterocyclyl, the phenyl, the 5- or 6-membered monocyclic heteroaryl, or the 8- to 10-membered bicyclic heteroaryl is optionally substituted with 1 or 2 groups selected from the following group consisting of: halogen, hydroxy, carboxyl, nitro, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, deuterated $C_{1-6}$ alkyl, $C_{1-6}$ alkoxy, $C_{1-6}$ haloalkoxy, deuterated $C_{1-6}$ alkoxy, -$NH_2$, -NH$C_{1-6}$ alkyl, -N($C_{1-6}$ alkyl)$_2$, -$C_{1-4}$ alkyl-P(=O)-($C_{1-6}$ alkyl)$_2$, and -P(=O)-($C_{1-6}$ alkyl)$_2$; or

each $R^{a1}$ and $R^{b1}$, together with the nitrogen atom to which they are attached, form 3- to 20-membered heterocyclyl; wherein, each 3- to 20-membered heterocyclyl is independently and optionally substituted with 1 or 2 groups selected from the following group consisting of: halogen, hydroxy, carboxyl, nitro, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, deuterated $C_{1-6}$ alkyl, $C_{1-6}$ alkoxy, $C_{1-6}$ haloalkoxy, deuterated $C_{1-6}$ alkoxy, -$NH_2$, -NH$C_{1-6}$ alkyl, -N($C_{1-6}$ alkyl)$_2$, -$C_{1-4}$ alkyl-P(=O)-($C_{1-6}$ alkyl)$_2$, and -P(=O)-($C_{1-6}$ alkyl)$_2$;

in the groups described above, each $R^{d1}$ is independently H, $C_{1-6}$ alkyl, or deuterated $C_{1-6}$ alkyl;

in the groups described above, each $R^{c1}$ is independently H, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, deuterated $C_{1-6}$ alkyl, $C_{1-6}$ alkoxy, $C_{1-6}$ haloalkoxy, deuterated $C_{1-6}$ alkoxy, -$C_{1-4}$ alkyl-$C_{1-6}$ haloalkyl, -$C_{1-4}$ alkyl-deuterated $C_{1-6}$ alkyl, -$C_{1-4}$ alkyl-$C_{1-6}$ alkoxy, -$C_{1-4}$ alkyl-$C_{1-6}$ haloalkoxy, -$C_{1-4}$ alkyl-deuterated $C_{1-6}$ alkoxy, $C_{3-6}$ monocyclic cycloalkyl, -$C_{1-4}$ alkyl-$C_{3-6}$ monocyclic cycloalkyl, -$C_{1-4}$ alkyl-O-$C_{3-6}$ monocyclic cycloalkyl, 3- to 6-membered monocyclic heterocyclyl, -$C_{1-4}$ alkyl-3- to 6-membered monocyclic heterocyclyl, -$C_{1-4}$ alkyl-O-3- to 6-membered monocyclic heterocyclyl, phenyl, -$C_{1-4}$ alkyl-phenyl, 5- or 6-membered monocyclic heteroaryl, -$C_{1-4}$ alkyl-5- or 6-membered monocyclic heteroaryl, 8-

to 10-membered bicyclic heteroaryl, or -$C_{1-4}$ alkyl-8- to 10-membered bicyclic heteroaryl; the $C_{3-6}$ monocyclic cycloalkyl, the 3- to 6-membered monocyclic heterocyclyl, the phenyl, the 5- or 6-membered monocyclic heteroaryl, or the 8- to 10-membered bicyclic heteroaryl is optionally substituted with 1 or 2 groups selected from the following group consisting of: halogen, hydroxy, carboxyl, nitro, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, deuterated $C_{1-6}$ alkyl, $C_{1-6}$ alkoxy, $C_{1-6}$ haloalkoxy, deuterated $C_{1-6}$ alkoxy, -$NH_2$, -$NHC_{1-6}$ alkyl, -$N(C_{1-6}$ alkyl$)_2$, -$C_{1-4}$ alkyl-P(=O)-($C_{1-6}$ alkyl$)_2$, and -P(=O)-($C_{1-6}$ alkyl$)_2$;

in the groups described above, the groups of group S2 are each independently selected from the following group consisting of: deuterium, oxo (=O), thio (=S), =$CR^eR^f$, =$NR^e$, halogen, hydroxy, carboxyl, nitro, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, deuterated $C_{1-6}$ alkyl, $C_{1-6}$ alkoxy, $C_{1-6}$ haloalkoxy, deuterated $C_{1-6}$ alkoxy, -$NH_2$, -$NHC_{1-6}$ alkyl, -$N(C_{1-6}$ alkyl$)_2$, -(C=O)-$NHC_{1-6}$ alkyl, -(C=O)-$N(C_{1-6}$ alkyl$)_2$, -$C_{1-4}$ alkyl-P(=O)-($C_{1-6}$ alkyl$)_2$, -P(=O)-($C_{1-6}$ alkyl$)_2$, -(C=O)$C_{1-6}$ alkyl, and $SF_5$;

in the groups described above, the -$C_{1-4}$ alkyl- is unsubstituted; or 1, 2, 3, or 4 hydrogen atoms on the -$C_{1-4}$ alkyl- are each independently substituted with a group selected from halogen, cyano, hydroxy, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, deuterated $C_{1-6}$ alkyl, -$CH_2$-hydroxy, -$CH_2$-cyano, and phenyl; or 2 hydrogen atoms on the same carbon atom of the $C_{1-4}$ alkyl are both substituted with -$(CH_2)_j$- to form cycloalkyl, wherein j is 2, 3, 4, 5, or 6; or 2 hydrogen atoms on the same carbon atom of the $C_{1-4}$ alkyl are both substituted with =$CR^eR^f$;

in the groups described above, each $R^e$ is independently H, halogen, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, or deuterated $C_{1-6}$ alkyl;

in the groups described above, each $R^f$ is independently H, halogen, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, or deuterated $C_{1-6}$ alkyl;

in the groups described above, one or more (e.g., 1, 2, 3, or 4) ring atoms of the 3- to 8-membered heterocyclyl, 3- to 10-membered heterocyclyl, or 3- to 8-membered monocyclic heterocyclyl are heteroatoms selected from nitrogen, oxygen, sulfur, and phosphorus; one or more (e.g., 1, 2, 3, or 4) ring atoms of the $C_{1-6}$ heteroalkyl are heteroatoms selected from nitrogen, oxygen, sulfur, and phosphorus; one or more (e.g., 1, 2, 3, 4, or 5) ring atoms of the 7- to 12-membered

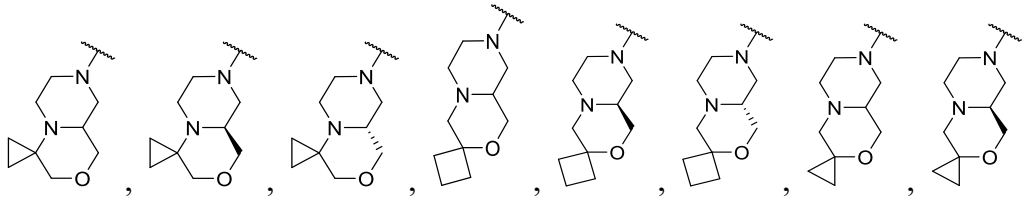
bicyclic heterocyclyl are heteroatoms selected from nitrogen, oxygen, sulfur, and phosphorus; one or more (e.g., 1, 2, 3, 4, or 5) ring atoms of the 3- to 20-membered heterocyclyl are heteroatoms selected from nitrogen, oxygen, sulfur, and phosphorus; one or more (e.g., 1, 2, 3, or 4) ring atoms of the 5- or 6-membered monocyclic heteroaryl are heteroatoms selected from nitrogen, oxygen, sulfur, and phosphorus; one or more (e.g., 1, 2, 3, 4, or 5) ring atoms of the 8- to 10-membered bicyclic heteroaryl are heteroatoms selected from nitrogen, oxygen, sulfur, and phosphorus; one or more (e.g., 1, 2, 3, or 4) ring atoms of the 3- to 6-membered monocyclic heterocyclyl are heteroatoms selected from nitrogen, oxygen, sulfur, and phosphorus; one or more (e.g., 1, 2, 3, 4, or 5) ring atoms of the 5- to 15-membered tricyclic heterocyclyl are heteroatoms selected from nitrogen, oxygen, sulfur, and phosphorus;

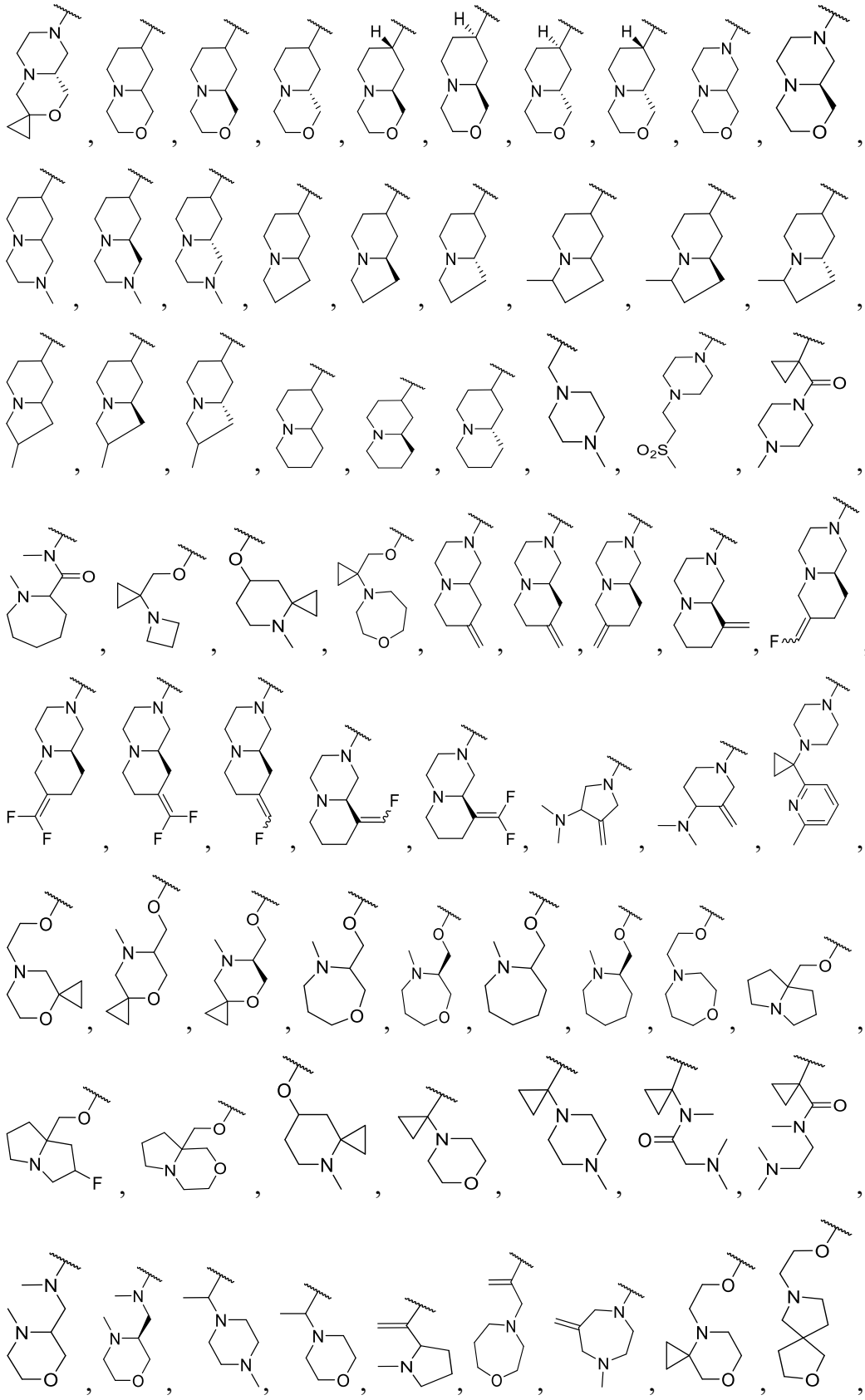
wherein, when the ring atom is a sulfur atom, the sulfur atom is optionally substituted with one or two groups selected from oxo and $=NR^e$; $R^e$ is as defined above;

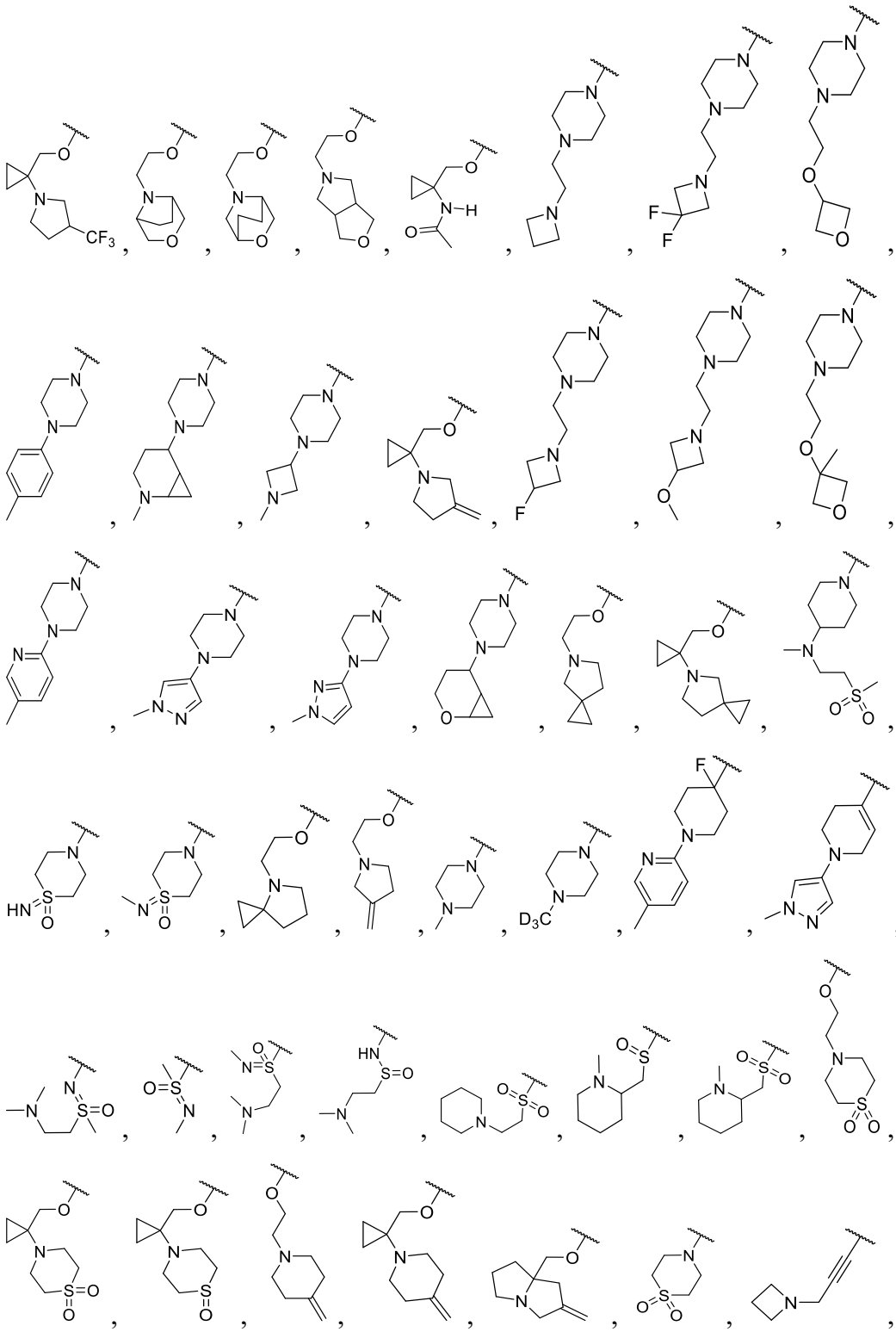
wherein, when the ring atom is a phosphorus atom, the phosphorus atom is optionally substituted with one or two groups selected from oxo and $=NR^e$; $R^e$ is as defined above.

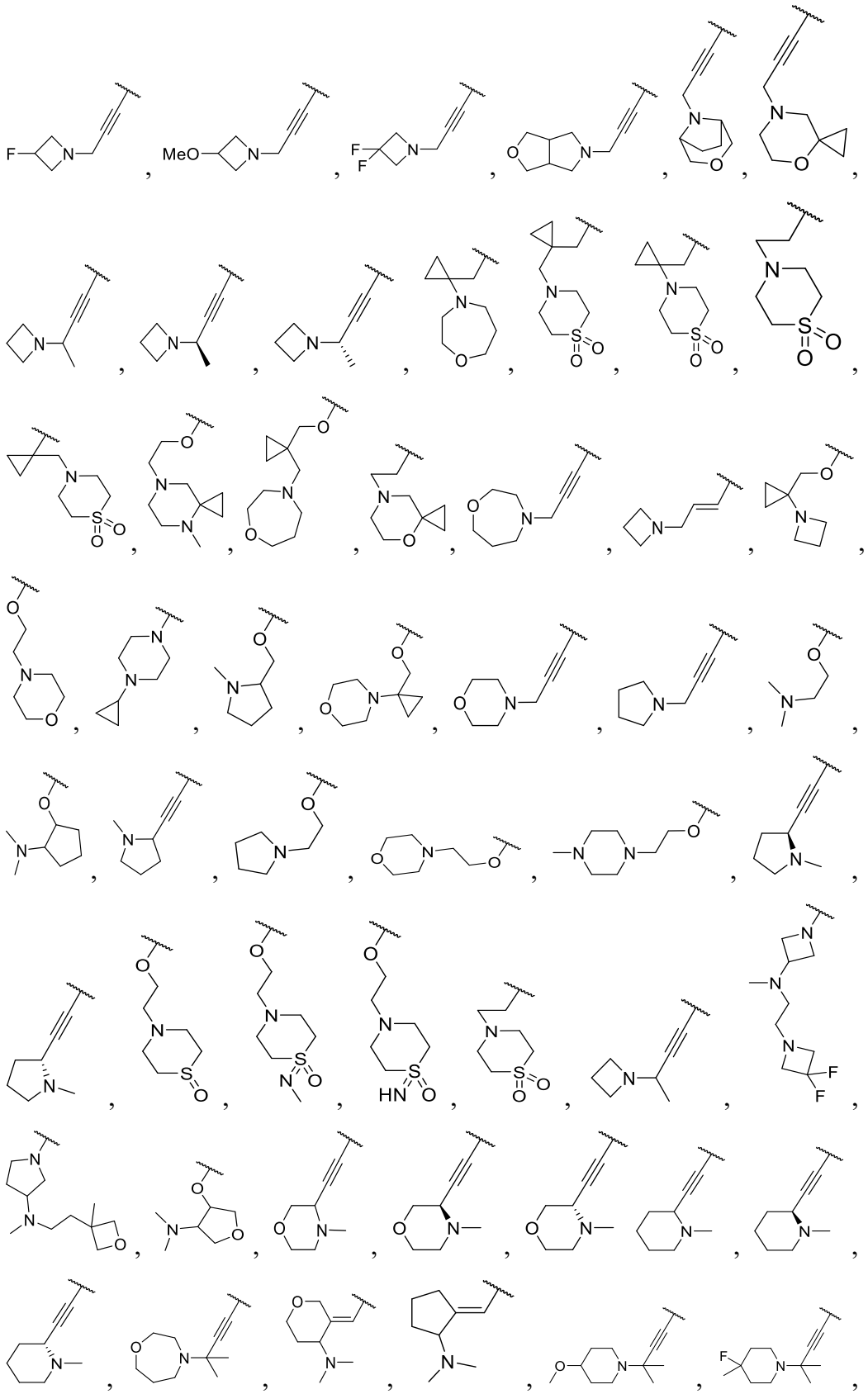
5. The compound, or the stable deuterated derivative thereof, or the stereoisomer thereof, or the pharmaceutically acceptable salt thereof, the solvate thereof, or the prodrug thereof according to claim 1, wherein, $R_{4a}$ is -$C_{1-6}$ alkyl-$C_{1-6}$ alkoxy.

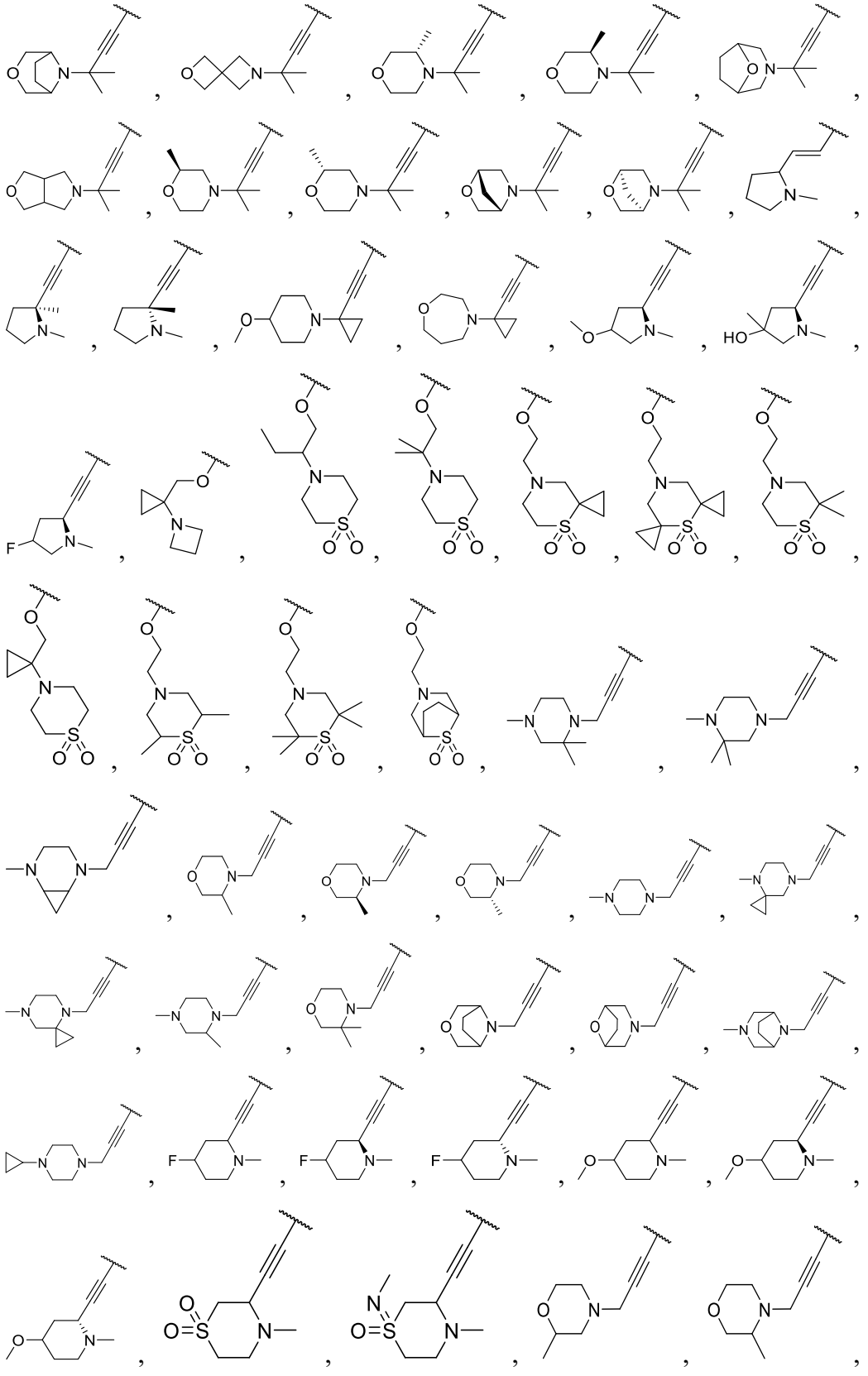
6. The compound, or the stable deuterated derivative thereof, or the stereoisomer thereof, or the pharmaceutically acceptable salt thereof, the solvate thereof, or the prodrug thereof according to claim 1, wherein, $R_5$ is selected from hydrogen,

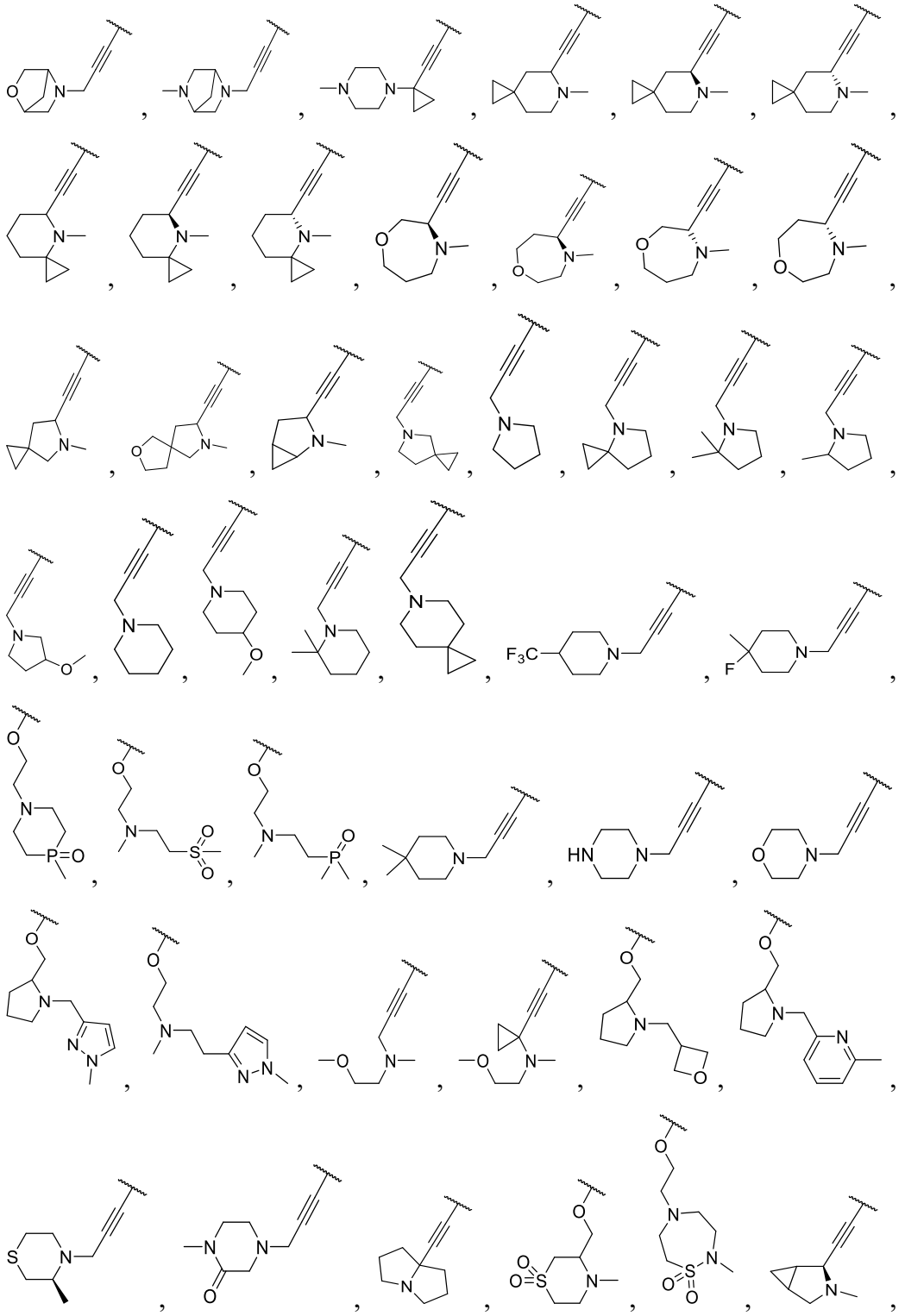


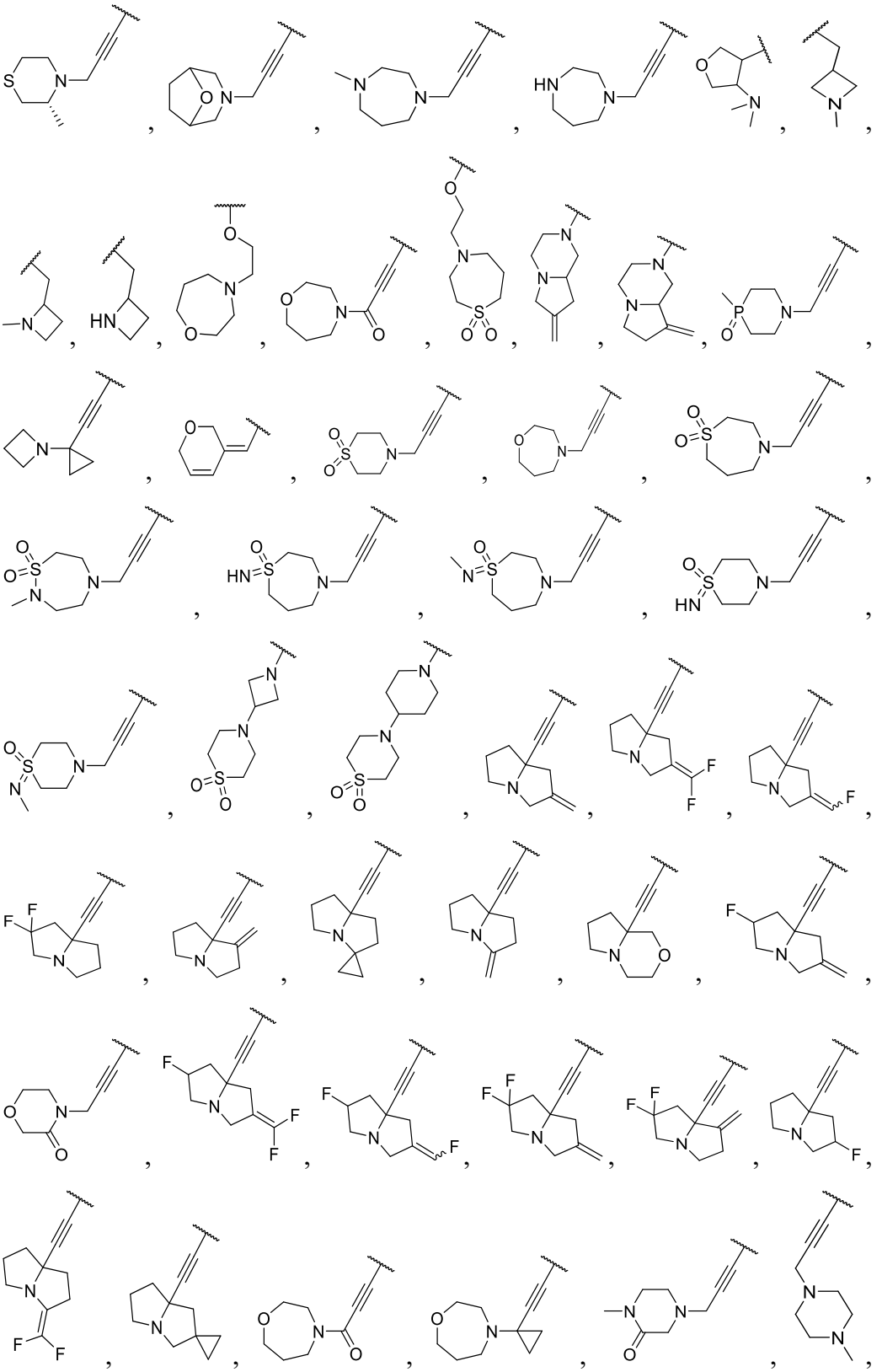


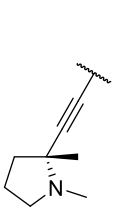








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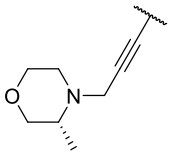
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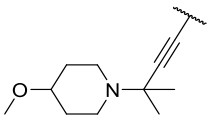
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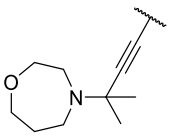
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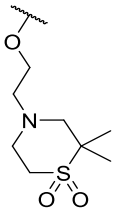
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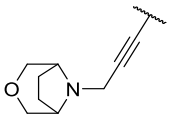
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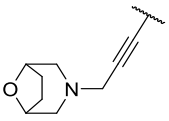
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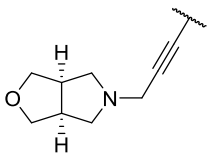
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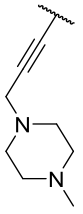
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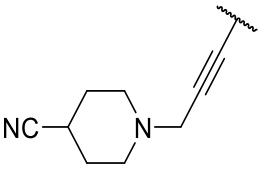
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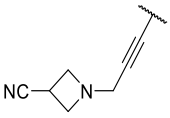
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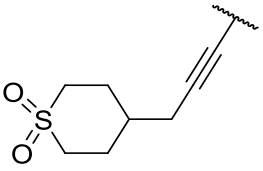
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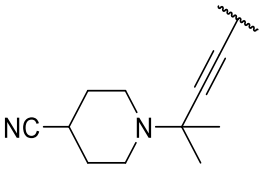
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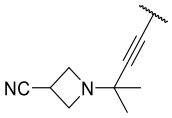
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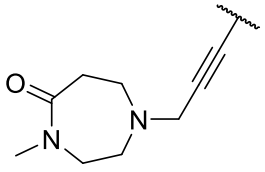
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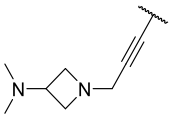
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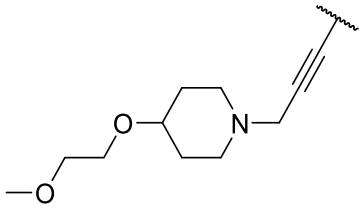
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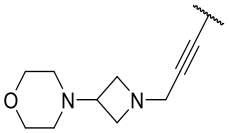
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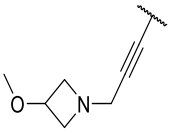
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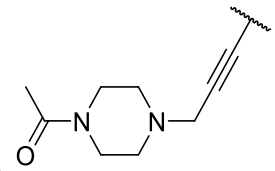
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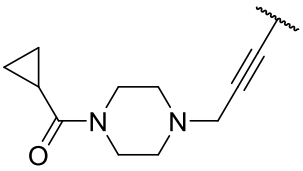
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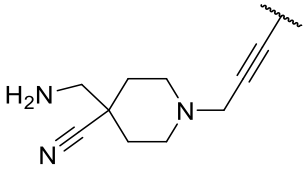
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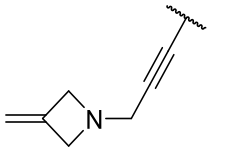
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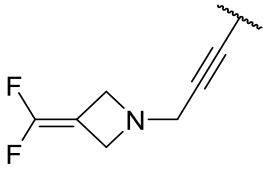
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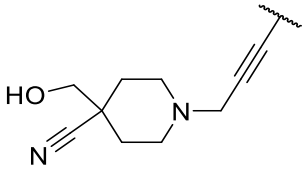
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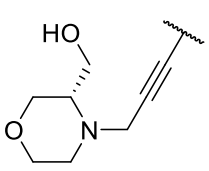
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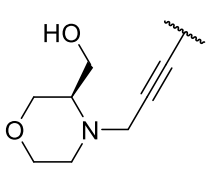
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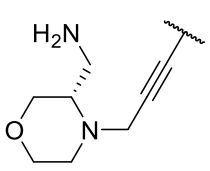
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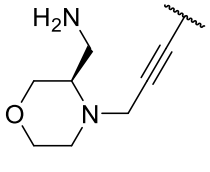
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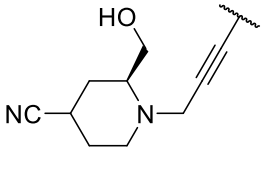
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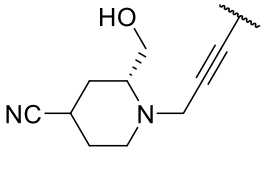
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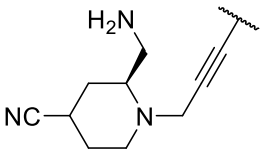
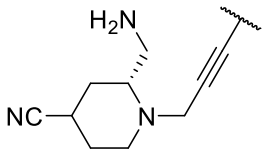


, and 

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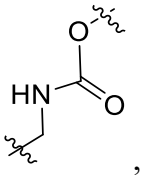
7. The compound, or the stable deuterated derivative thereof, or the stereoisomer thereof, or the pharmaceutically acceptable salt thereof, the solvate thereof, or the prodrug thereof according to claim 1, wherein, $R_3$ is hydrogen, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, deuterated $C_{1-6}$ alkyl, or $C_{3-6}$ cycloalkyl; or
$R_1$ is hydrogen; $R_2$ is hydrogen.

8. The compound, or the stable deuterated derivative thereof, or the stereoisomer thereof, or the pharmaceutically acceptable salt thereof, the solvate thereof, or the prodrug thereof according to claim 1, wherein, $L_1$ is selected from 

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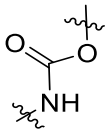
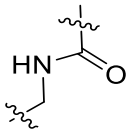
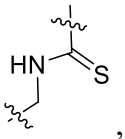
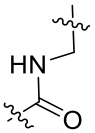
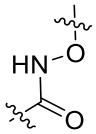
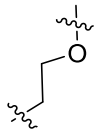


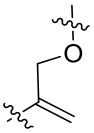
, 

, 

, 

, 

, 

, 

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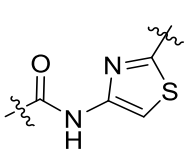
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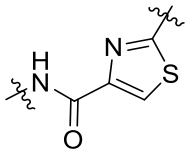
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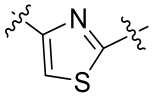
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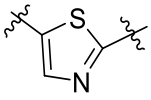
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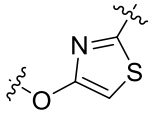
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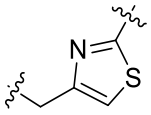
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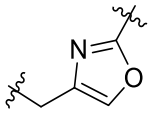
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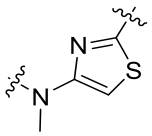
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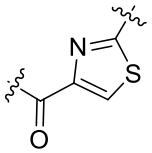
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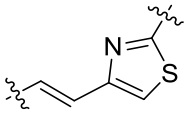
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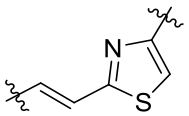
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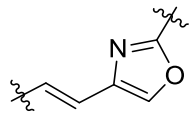
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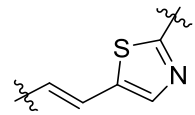
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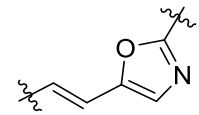
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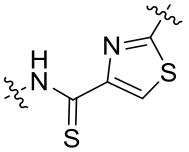
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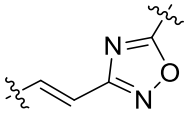
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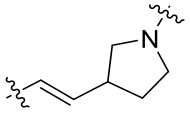
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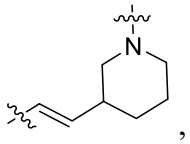
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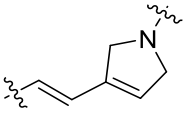
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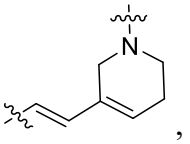
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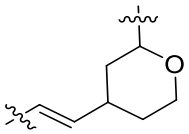
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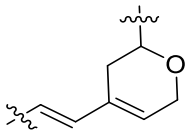
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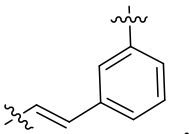
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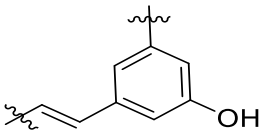
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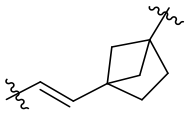
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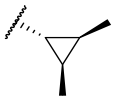
9. The compound, or the stable deuterated derivative thereof, or the stereoisomer thereof, or the pharmaceutically acceptable salt thereof, the solvate thereof, or the prodrug thereof according to claim 1, wherein, $R_6$ is selected from

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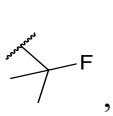
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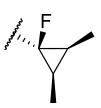
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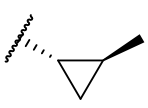
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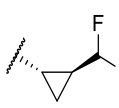
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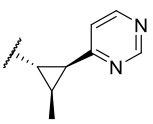
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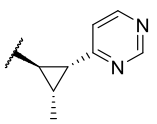
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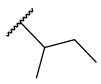
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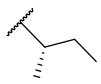
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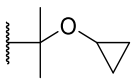
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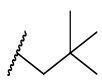
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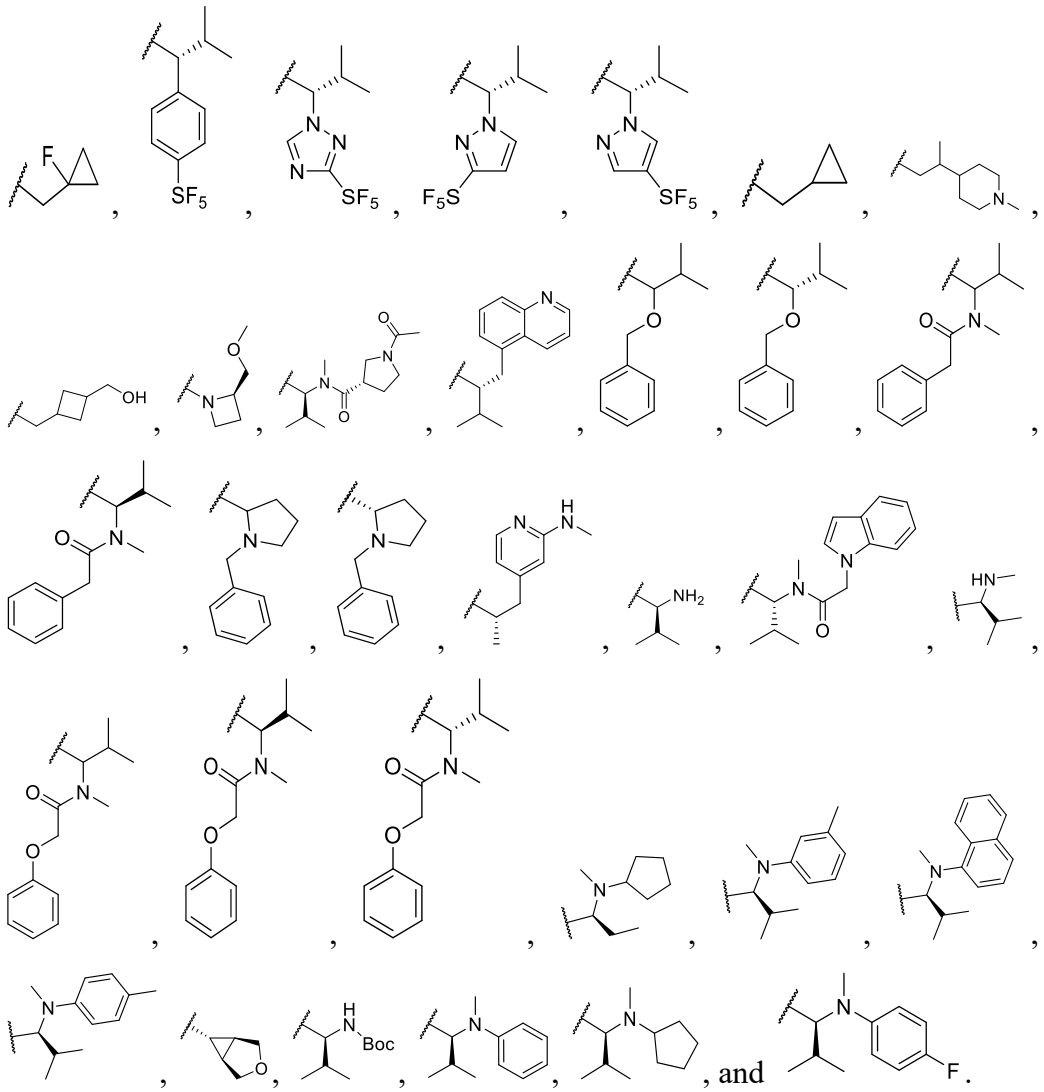

10. The compound, or the stable deuterated derivative thereof, or the stereoisomer thereof, or the pharmaceutically acceptable salt thereof, the solvate thereof, or the prodrug thereof according to claim 1, wherein, the compound is selected from Table A, Table B, and Table C.

11. A pharmaceutical composition, comprising the compound, or the stable deuterated derivative thereof, or the stereoisomer thereof, or the pharmaceutically acceptable salt thereof, the solvate thereof, or the prodrug thereof according to any one of claims 1 to 10, and a pharmaceutically acceptable carrier.

12. Use of the compound, or the stable deuterated derivative thereof, or the stereoisomer thereof, or the pharmaceutically acceptable salt thereof, the solvate thereof, or the prodrug thereof according to any one of claims 1 to 10, or the pharmaceutical composition according to claim 11 in the manufacture of a medicament for preventing and/or treating a disease or disorder associated with RAS protein activity; or

wherein, the disease or disorder associated with RAS protein activity is a cancer; orwherein, the cancer is pancreatic cancer, colorectal cancer, non-small cell lung cancer, acute myeloid leukemia, multiple myeloma, thyroid adenocarcinoma, myelodysplastic syndrome, squamous cell carcinoma of lung, esophageal cancer, ovarian cancer, uterine cancer, melanoma, bladder cancer, or head and neck cancer.

13. The compound, or the stable deuterated derivative thereof, or the stereoisomer thereof, or the pharmaceutically acceptable salt thereof, the solvate thereof, or the prodrug thereof according to any one of claims 1 to 10, or the pharmaceutical composition according to claim 11, for use in preventing and/or treating a disease or disorder associated with RAS protein activity; or

the disease or disorder associated with RAS protein activity is a cancer; or

the cancer is pancreatic cancer, colorectal cancer, non-small cell lung cancer, acute myeloid leukemia, multiple myeloma, thyroid adenocarcinoma, myelodysplastic syndrome, squamous cell carcinoma of lung, esophageal cancer, ovarian cancer, uterine cancer, melanoma, bladder cancer, or head and neck cancer.