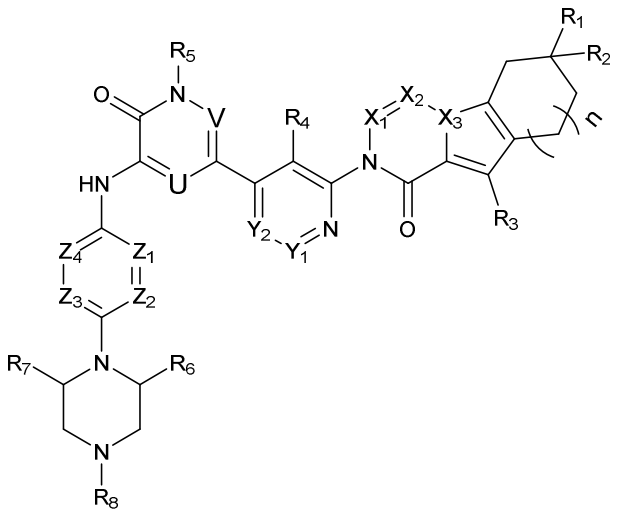
CLAIMS

1. A compound of formula (I):



(I)

or a pharmaceutically acceptable salt thereof, or a solvate, a racemic mixture, an enantiomer, a diastereomer or a tautomer thereof, wherein

X_1 and X_2 are each independently CH or N;

X_3 is N;

U and V are each independently N or CR_9;

Y_1 and Y_2 are each independently CR_{10} or N;

R_1 and R_2 are each independently selected from hydrogen, deuterium, halogen, -CN, hydroxyl, C_{1-6} alkyl, 3-6 membered cycloalkyl, C_{2-6} alkynyl, C_{1-6} deuteroalkyl and C_{1-6} haloalkyl;

R_3 is hydrogen, deuterium, halogen, -CN or C_{1-6} haloalkyl;

R_4 is hydrogen, halogen, -CN, C_{1-6} alkyl, C_{2-6} alkynyl, -(C_{1-3} alkyl)-OH, -(C_{1-3} alkyl)-O-(C_{1-3} alkyl), -O-(C_{1-3} alkyl), -CHO, $-C(O)NH_2$, $-C(O)NHCH_3$, $-C(O)N(CH_3)_2$ or 3-hydroxyl-oxetan-3-yl, wherein the C_{1-6} alkyl or C_{1-3} alkyl is each optionally substituted with one or more deuterium or halogen;

R_5 is selected from hydrogen, C_{1-6} alkyl and C_{3-6} cycloalkyl, wherein the C_{1-6} alkyl is optionally substituted with one or more deuterium or halogen;

Z_1, Z_2, Z_3 and Z_4 are each independently CH or N, provided that at least one of Z_1, Z_2, Z_3 and Z_4 is N;

R_6 and R_7 are each independently selected from C_{1-6} alkyl;

R_8 is hydrogen, C_{1-6} alkyl, C_{3-6} cycloalkyl or 4-8 membered heterocyclyl, wherein the C_{1-6} alkyl, C_{3-6} cycloalkyl or 4-8 membered heterocyclyl is optionally substituted with one or more groups selected from: deuterium, halogen, C_{1-6} alkyl, trifluoromethyl, -OH, $-NH_2$, -O-(C_{1-6} alkyl), -NH(C_{1-6} alkyl) and -N(C_{1-6} alkyl)$_2$;

R_9 is hydrogen, deuterium or halogen;

R_{10} is hydrogen, deuterium, halogen, CN, C_{1-6} alkyl or C_{1-6} haloalkyl; and

n is 0.

2. The compound or the pharmaceutically acceptable salt thereof, or the solvate, the racemic mixture, the enantiomer, the diastereomer or the tautomer thereof according to claim 1, wherein

X_1 and X_2 are each independently CH or N;

X_3 is N;

U and V are each independently CR_9;

Y_1 and Y_2 are each independently CR_{10};

R_1 and R_2 are each independently selected from hydrogen, deuterium, halogen, -CN, hydroxyl, C_{1-6} alkyl, C_{1-6} deuteroalkyl and C_{1-6} haloalkyl;

R_3 is hydrogen or deuterium;

R_4 is -(C_{1-3} alkyl)-OH, $-C(O)NH_2$, $-C(O)NHCH_3$ or $-C(O)N(CH_3)_2$, wherein the C_{1-3} alkyl is optionally substituted with one or more deuterium;

R_5 is selected from hydrogen and C_{1-6} alkyl, wherein the C_{1-6} alkyl is optionally substituted with one or more deuterium;

Z_1, Z_2, Z_3 and Z_4 are each independently CH or N, provided that at least one of Z_1, Z_2, Z_3 and Z_4 is N;

R_6 and R_7 are each independently selected from C_{1-6} alkyl;

R_8 is hydrogen, C_{1-6} alkyl, C_{3-6} cycloalkyl or 4-8 membered heterocyclyl, wherein the C_{1-6} alkyl, C_{3-6} cycloalkyl or 4-8 membered heterocyclyl is optionally substituted with one or more groups selected from: deuterium, halogen, C_{1-6} alkyl, trifluoromethyl, -OH and $-NH_2$;

R_9 is hydrogen or deuterium;

R_{10} is hydrogen or deuterium; and

n is 0.

3. The compound or the pharmaceutically acceptable salt thereof, or the solvate, the racemic mixture, the enantiomer, the diastereomer or the tautomer thereof according to any one of claims 1-2, wherein both X_1 and X_2 are CH.

4. The compound or the pharmaceutically acceptable salt thereof, or the solvate, the racemic mixture, the enantiomer, the diastereomer or the tautomer thereof according to any one of claims 1-3, wherein both Y_1 and Y_2 are CR_{10}.

5. The compound or the pharmaceutically acceptable salt thereof, or the solvate, the racemic mixture, the enantiomer, the diastereomer or the tautomer thereof according to claim 4, wherein R_{10} is hydrogen.

6. The compound or the pharmaceutically acceptable salt thereof, or the solvate, the racemic mixture, the enantiomer, the diastereomer or the tautomer thereof according to any one of claims 1-5, wherein R_1 and R_2 are each independently selected from methyl.

7. The compound or the pharmaceutically acceptable salt thereof, or the solvate, the racemic mixture, the enantiomer, the diastereomer or the tautomer thereof according to any one of claims 1-6, wherein R_3 is hydrogen.

8. The compound or the pharmaceutically acceptable salt thereof, or the solvate, the racemic mixture, the enantiomer, the diastereomer or the tautomer thereof according to any one of claims 1-7, wherein R_4 is -(C_{1-3} alkyl)-OH or -(C_{1-3} deuteroalkyl)-OH.

9. The compound or the pharmaceutically acceptable salt thereof, or the solvate, the racemic mixture, the enantiomer, the diastereomer or the tautomer thereof according to any one of claims 1-8, wherein R_3 is hydrogen, and R_4 is -(C_{1-3} alkyl)-OH.

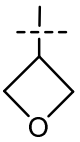
10. The compound or the pharmaceutically acceptable salt thereof, or the solvate, the racemic mixture, the enantiomer, the diastereomer or the tautomer thereof according to any one of claims 1-9, wherein both U and V are CH.

11. The compound or the pharmaceutically acceptable salt thereof, or the solvate, the racemic mixture, the enantiomer, the diastereomer or the tautomer thereof according to any one of claims 1-10, wherein R_5 is C_{1-6} alkyl.

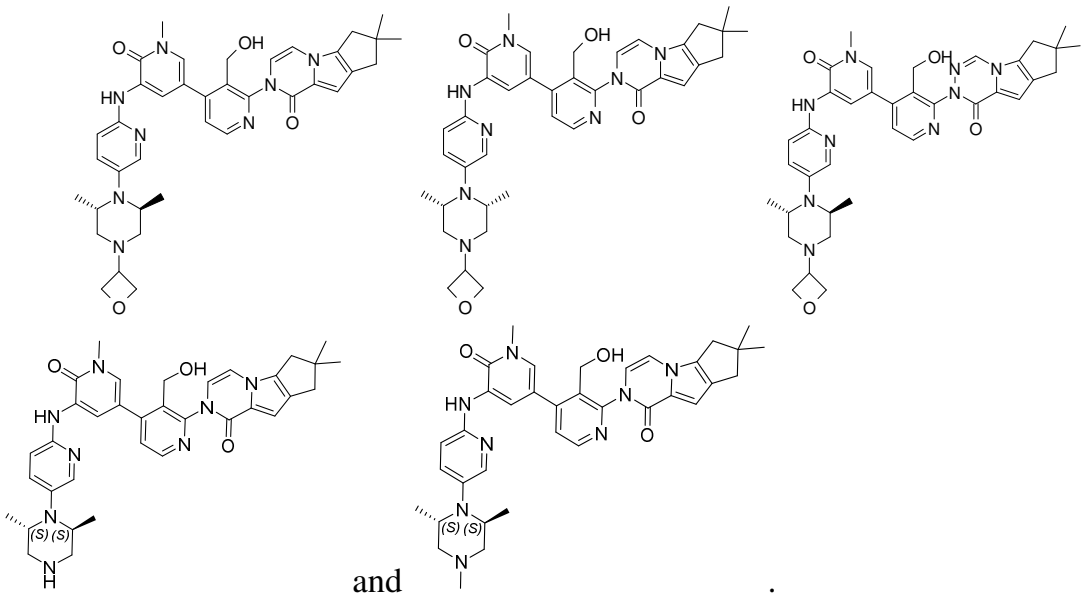
12. The compound or the pharmaceutically acceptable salt thereof, or the solvate, the racemic mixture, the enantiomer, the diastereomer or the tautomer thereof according to any one of claims 1-11, wherein Z_1 is N, and Z_2, Z_3 and Z_4 are all CH.

13. The compound or the pharmaceutically acceptable salt thereof, or the solvate, the racemic mixture, the enantiomer, the diastereomer or the tautomer thereof according to any one of claims 1-12, wherein both R_6 and R_7 are methyl.

14. The compound or the pharmaceutically acceptable salt thereof, or the solvate, the racemic mixture, the enantiomer, the diastereomer or the tautomer thereof according to any one of claims 1-13, wherein R_8 is oxetanyl or tetrahydrofuranyl.

15. The compound or the pharmaceutically acceptable salt thereof, or the solvate, the racemic mixture, the enantiomer, the diastereomer or the tautomer thereof according to claim 14, wherein R_8 is .

16. The compound or the pharmaceutically acceptable salt thereof, or the solvate, the racemic mixture, the enantiomer, the diastereomer or the tautomer thereof according to claim 1, which is selected from:



and .

17. A pharmaceutical composition, comprising the compound and/or the pharmaceutically acceptable salt thereof according to any one of claims 1-16, and optionally comprising a pharmaceutically acceptable excipient.

18. A method of *in vitro* inhibiting the activity of BTK, comprising contacting BTK with an effective amount of the compound and/or the pharmaceutically acceptable salt thereof according to any one of claims 1-16.

19. Use of the compound and/or the pharmaceutically acceptable salt thereof according to any one of claims 1-16 in the manufacture of a medicament for treating or preventing an autoimmune disease, an inflammatory disease or cancer, wherein the inflammatory disease or autoimmune disease is preferably chosen from: systemic inflammation and local inflammation, arthritis, rheumatoid arthritis, inflammation associated with immunosuppression, organ-graft rejection, allergic disease, ulcerative colitis, Crohn's disease, dermatitis, asthma, lupus erythematosus, Sjogren syndrome, multiple sclerosis, scleroderma, osteoporosis, idiopathic thrombocytopenic purpura, autoimmune hemolytic anemia, antineutrophil cytoplasmic antibody vasculitis, chronic obstructive pulmonary disease, psoriasis, sicca syndrome, pemphigus vulgaris, diseases associated with kidney transplantation, autoimmune thyroid disease, chronic lymphocytic thyroiditis, hyperthyroidism, pernicious anemia with chronic atrophic gastritis,

goodpasture syndrome, pemphigoid, primary biliary cirrhosis, acute idiopathic polyneuritis, systemic lupus erythematosus, and mixed connective tissue disease; the cancer is preferably solid tumor or hematologic malignancy, including lymphoma, leukemia and myeloma; and the cancer is more preferably chosen from B cell malignancy, diffuse large B-cell lymphoma (DLBCL), large B-cell lymphoma (LBCL), B-cell lymphoma, mantle cell lymphoma, follicular lymphoma, non-Hodgkin's lymphoma, Hodgkin's lymphoma, Waldenström's macroglobulinaemia, marginal zone lymphoma, Burkitt's lymphoma, highly aggressive B cell non-Burkitt's lymphoma, extranodal marginal-zone B-cell lymphoma, small lymphotic lymphoma (SLL), lymphoblastic lymphoma, lymphocytic leukemia, myelogenous leukemia, acute myelogenous leukemia (AML), chronic myelogenous leukemia (CML), human acute monocytic leukemia, acute lymphocytic leukemia (ALL), B cell acute lymphocytic leukemia (B-ALL), hairy cell leukemia, chronic lymphocytic leukemia (CLL) (such as high risk CLL), myelodysplastic syndrome, acute lymphoblastic leukemia, myeloma (such as multiple myeloma) or graft versus host disease.

20. The compound and/or the pharmaceutically acceptable salt thereof according to any one of claims 1-16, for use as a medicament.

21. The compound and/or the pharmaceutically acceptable salt thereof according to any one of claims 1-16, for use in treating or preventing an autoimmune disease, an inflammatory disease or cancer, wherein the inflammatory disease or autoimmune disease is preferably chosen from: systemic inflammation and local inflammation, arthritis, rheumatoid arthritis, inflammation associated with immunosuppression, organ-graft rejection, allergic disease, ulcerative colitis, Crohn's disease, dermatitis, asthma, lupus erythematosus, Sjogren syndrome, multiple sclerosis, scleroderma, osteoporosis, idiopathic thrombocytopenic purpura, autoimmune hemolytic anemia, antineutrophil cytoplasmic antibody vasculitis, chronic obstructive pulmonary disease, psoriasis, sicca syndrome, pemphigus vulgaris, diseases associated with kidney transplantation, autoimmune thyroid disease, chronic lymphocytic thyroiditis, hyperthyroidism, pernicious anemia with chronic atrophic gastritis, goodpasture syndrome, pemphigoid, primary biliary cirrhosis, acute idiopathic polyneuritis, systemic lupus erythematosus,

and mixed connective tissue disease; the cancer is preferably solid tumor or hematologic malignancy, including lymphoma, leukemia and myeloma; and the cancer is more preferably chosen from B cell malignancy, diffuse large B-cell lymphoma (DLBCL), large B-cell lymphoma (LBCL), B-cell lymphoma, mantle cell lymphoma, follicular lymphoma, non-Hodgkin's lymphoma, Hodgkin's lymphoma, Waldenström's macroglobulinaemia, marginal zone lymphoma, Burkitt's lymphoma, highly aggressive B cell non-Burkitt's lymphoma, extranodal marginal-zone B-cell lymphoma, small lymphotic lymphoma (SLL), lymphoblastic lymphoma, lymphocytic leukemia, myelogenous leukemia, acute myelogenous leukemia (AML), chronic myelogenous leukemia (CML), human acute monocytic leukemia, acute lymphocytic leukemia (ALL), B cell acute lymphocytic leukemia (B-ALL), hairy cell leukemia, chronic lymphocytic leukemia (CLL) (such as high risk CLL), myelodysplastic syndrome, acute lymphoblastic leukemia, myeloma (such as multiple myeloma) or graft versus host disease.

22. A pharmaceutical combination, comprising the compound and/or the pharmaceutically acceptable salt thereof according to any one of claims 1-16, and at least one additional therapeutic agent, wherein the therapeutic agent is preferably chosen from: an anti-inflammatory agent, an immunomodulator or an anti-tumor active agent, wherein the anti-tumor active agent includes a chemotherapeutic agent, an immune checkpoint inhibitor or agonist, and a targeted therapeutic agent.