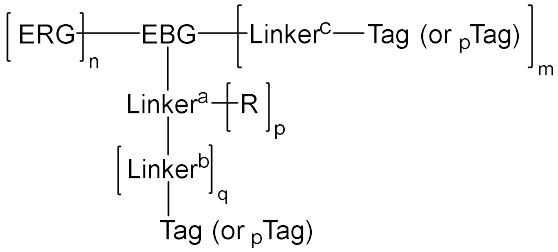
CLAIMS

1. A probe having a structure satisfying Formula II

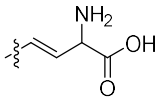


Formula II

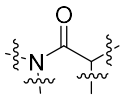
wherein

ERG, if present, is $S(O)_2OH$, or an anionic form thereof; $P(O(OH)_2$, or an anionic form thereof; a halogen; or -OPh-CH_2-ONO_2;

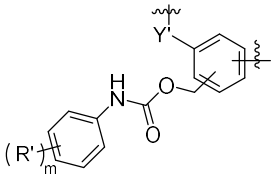
EBG has a structure satisfying one or more of Formulas IIA_{EBG}- IIJ_{EBG}



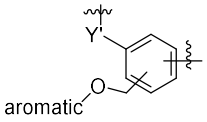
Formula IIB_{EBG};



Formula IIC_{EBG};



Formula IIE_{EBG}

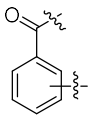


Formula IIF_{EBG}

or



Formula IIG_{EBG};



Formula IIH_{EBG};

wherein Y is CH_3 or CF_3; Y' is O, NO_2, or -N=NR'', wherein R'' is a dye or other reporting moiety; and m is an integer selected from 0 to 5; and R' is selected from aldehyde, ketone, ester, carboxylic acid, acyl, acyl halide, cyano, sulfonate, nitro, nitroso, quaternary amine, CF_3, alkyl halide, or combinations thereof;

$Linker^a$ comprises an aliphatic group, a heteroaliphatic group, an aromatic group, an aliphatic-aromatic group, a heteroaliphatic-aromatic group, a heteroaromatic group, an aliphatic-heteroaromatic group, or a heteroaliphatic-heteroaromatic group;

each of $Linker^b$, and $Linker^c$, if present, independently comprises an aliphatic group, a heteroaliphatic group, an aromatic group, an aliphatic-aromatic group, a heteroaliphatic-aromatic group, a heteroaromatic group, an aliphatic-heteroaromatic group, or a heteroaliphatic-heteroaromatic group;

R, if present, is a group comprising a carbamate or a carbonate;

each Tag, if present, independently comprises a functional group or molecule capable of generating a detectable signal;

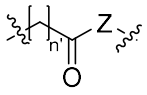
each $_p$Tag, which is present if a Tag is not present, independently comprises a clickable functional group; and

each of n, m, p, and q independently is 0 or 1.

2. The probe of claim 1, wherein Linker^a is a linker group having a structure satisfying one or more of Formulas $IIA_{Linkera}$-$IIH_{Linkera}$



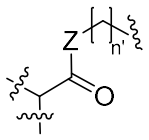
Formula $IIA_{linkera}$



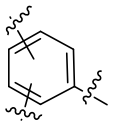
Formula $IIB_{linkera}$



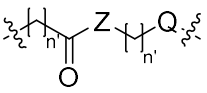
Formula $IIC_{linkera}$



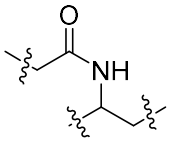
Formula $IID_{linkera}$



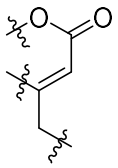
Formula $IIE_{linkera}$



Formula $IIF_{linkera}$



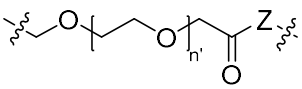
Formula $IIG_{linkera}$



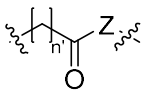
Formula $IIH_{linkera}$

wherein each n' independently is an integer ranging from 1 to 50; Z is oxygen or NR"', wherein R"' is hydrogen, aliphatic, or aromatic; and Q is carbon, oxygen or NR"', wherein R"' is hydrogen, aliphatic, or aromatic.

3. The probe of any one of claims 1-2, wherein Linker^c is present and has a structure satisfying Formula $IIA_{Linkerc}$ or Formula $IIB_{Linkerc}$



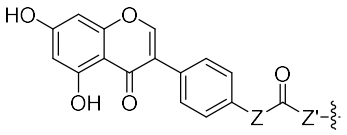
Formula $IIA_{Linkerc}$



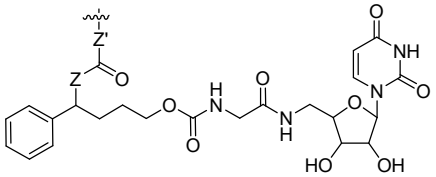
Formula $IIB_{Linkerc}$

wherein n' is an integer ranging from 0 to 50; and Z is oxygen or NR'", wherein R'" is hydrogen, aliphatic, or aromatic.

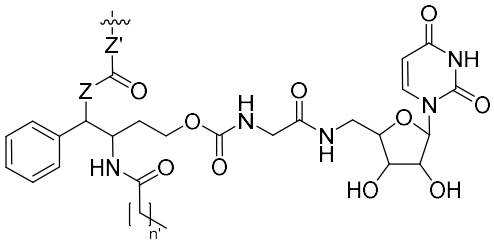
4. The probe of any one of claims 1-3, wherein R is present and has a structure satisfying any one or more Formulas IIA_R-IIC_R



Formula IIA_R



Formula IIB_R



Formula IIC_R

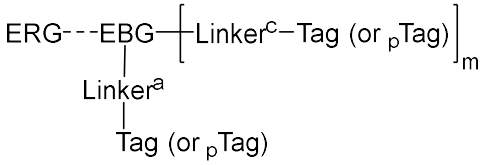
wherein Z and Z' independently are oxygen or NR'", wherein R'" is hydrogen, aliphatic, or aromatic; and n' is an integer ranging from 0 to 50.

5. The probe of any one of claims 1-4, wherein one or more Tags are present and wherein each Tag independently is a fluorophore, a binding partner of an affinity-based binding pair, a quantum dot, or a dye.

6. The probe of claim 5, wherein the one or more Tags independently are rhodamine, fluorescein, or biotin.

7. The probe of any one of claims 1-4, wherein one or more $_p$Tags are present and wherein each $_p$Tag independently is an azide or an alkyne.

8. The probe of claim 1, wherein the compound has a structure satisfying Formula IIIA



Formula IIIA.

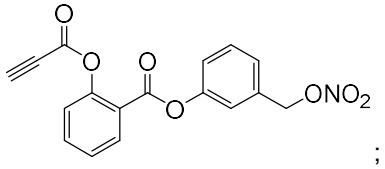
9. The probe of claim 8, wherein the ERG is present and is iodo or -OPh-CH_2-ONO_2.

10. The probe of any one of claims 8-9, wherein Linker[a] is an ester group, an -O$(CH_2)_{n'}$NR'''C(O)$(CH_2)_{n'}$- group, or a -$(CH_2)_{n'}$- group, wherein each n' independently is an integer ranging from 1 to 20 and wherein R''' is hydrogen, aliphatic, or aromatic.

11. The probe of any one of claims 8-10, wherein m is 1 and Linker[c] is an -NR'''C(O)$(CH_2)_{n'}$- group or an –NR'''C(O)$CH_2[O(CH_2)_2]_{n'}OCH_2$- group, wherein each n' independently is an integer ranging from 1 to 20 and wherein R''' is hydrogen, aliphatic, or aromatic.

12. The probe of any one of claims 8-11, wherein m is 1 and each Tag, if present, independently is a fluorophore, a binding partner of an affinity-based binding pair, a quantum dot, or a dye; or if a $_p$Tag group is present, then each $_p$Tag independently is an alkyne or an azide.

13. A probe selected from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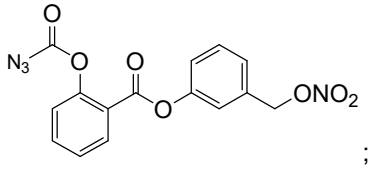
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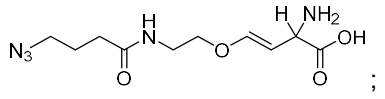
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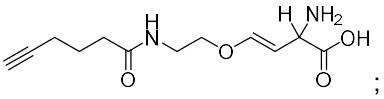
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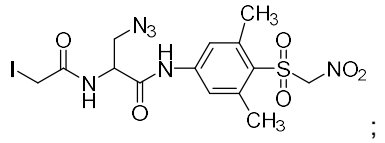
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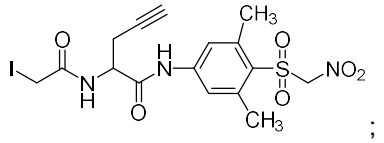
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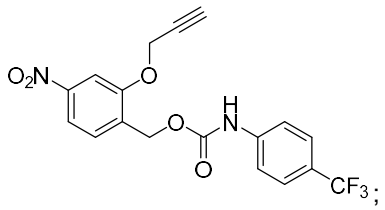
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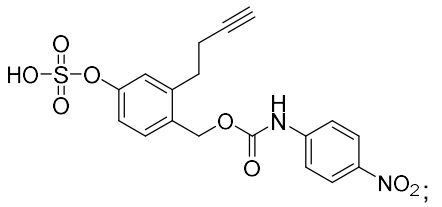
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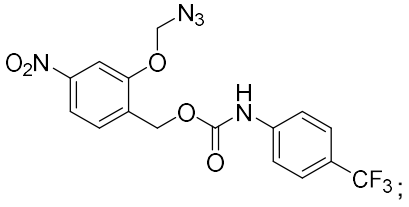
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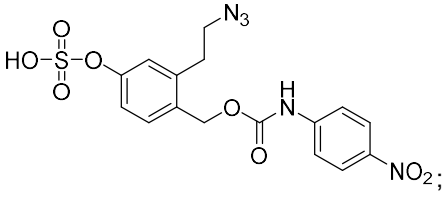
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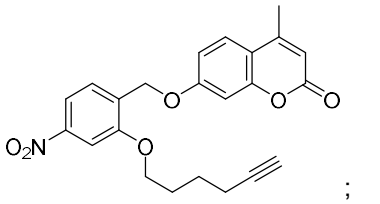
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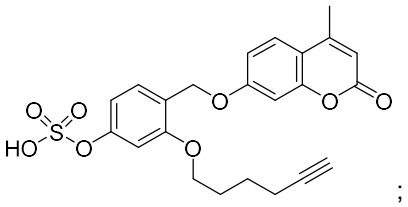
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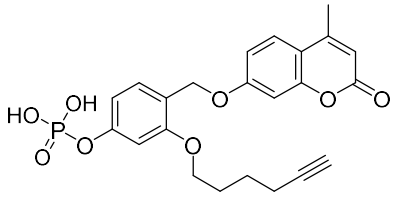
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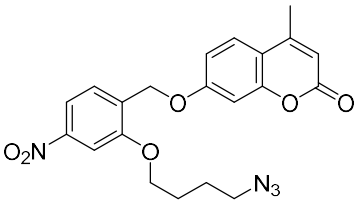

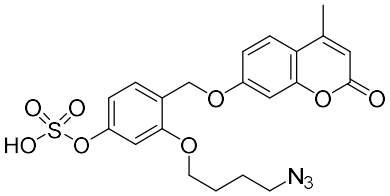

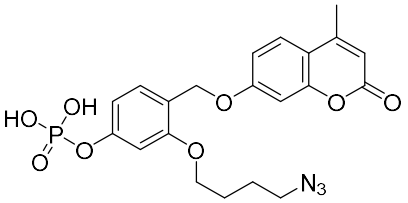

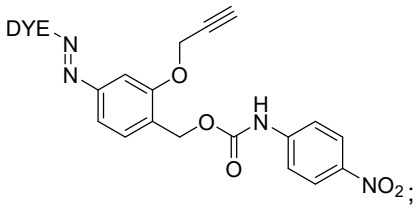
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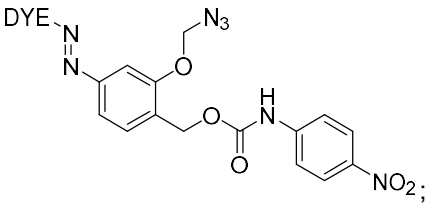
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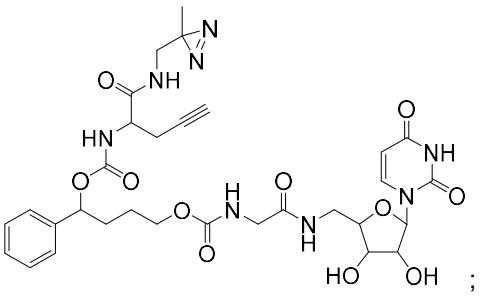
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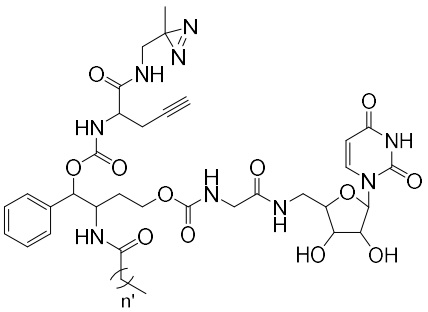
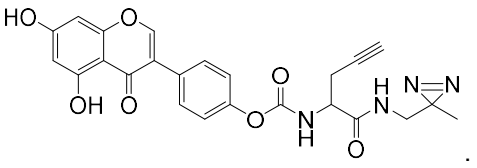


wherein n’ is 0 to 50; or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14. A method, comprising:

exposing a subject or a sample to a probe according to any one of claims 1-13 for a time sufficient to allow the probe to bind to an enzyme involved in xenobiotic metabolism such that a probe-enzyme conjugate is formed; and

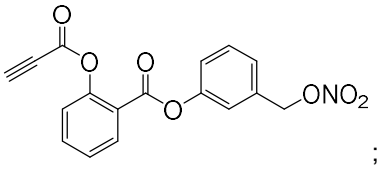
analyzing the probe-enzyme conjugate using a fluorescent detection technique, a colorimetric detection technique, a mass spectrometry technique, or a combination thereof.

15. The method of claim 14, further comprising exposing the probe-enzyme conjugate to a Tag-containing compound to form a probe-enzyme conjugate comprising a Tag moiety.

16. The method of claim 14 or 15, further comprising exposing the probe to a light source.

17. The method of any one of claims 14-16, further comprising extracting a subject sample from the subject and analyzing the subject sample using a fluorescent detection technique, a colorimetric detection technique, a mass spectrometry technique, or a combination thereof.

18. The method of any one of claims 14-17, wherein the probe is selected from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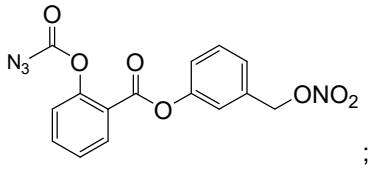
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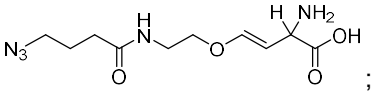
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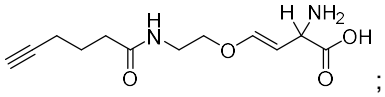
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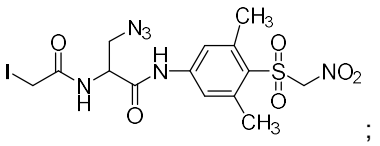
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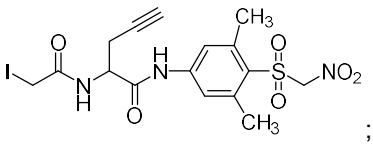
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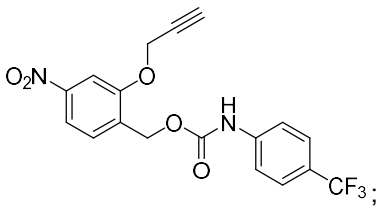
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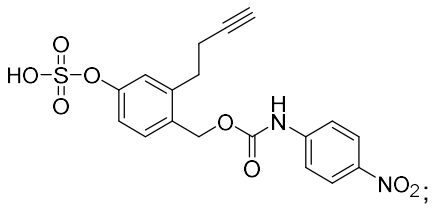
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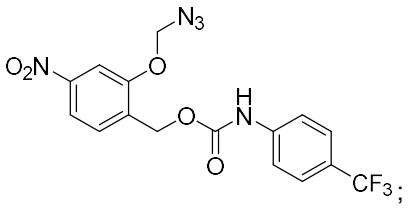
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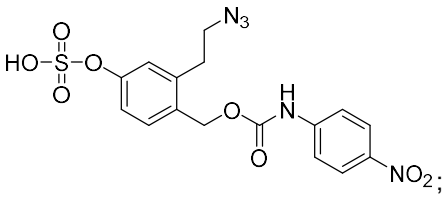
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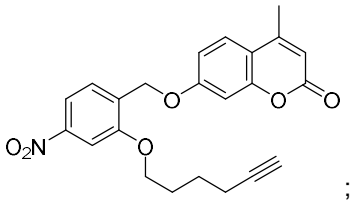
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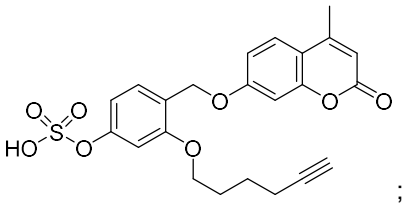
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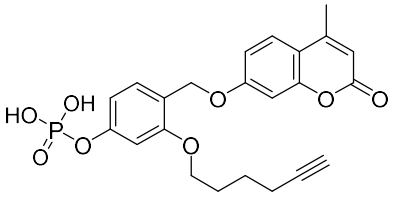
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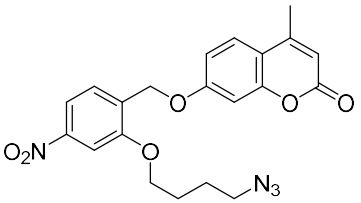

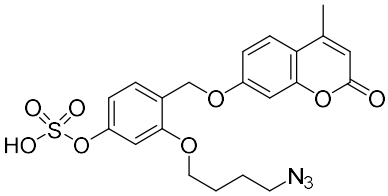

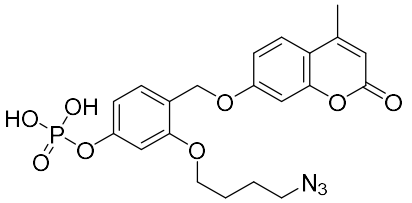

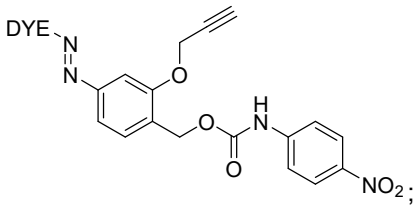
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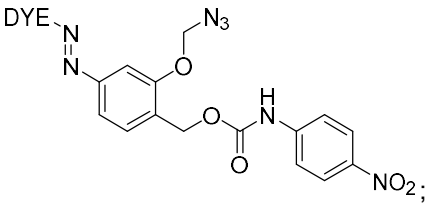
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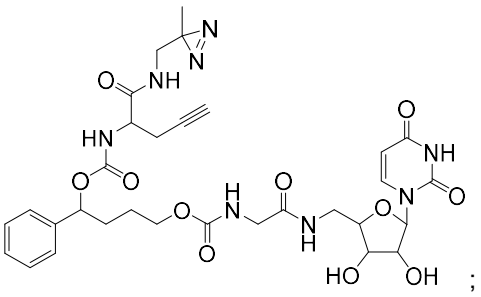
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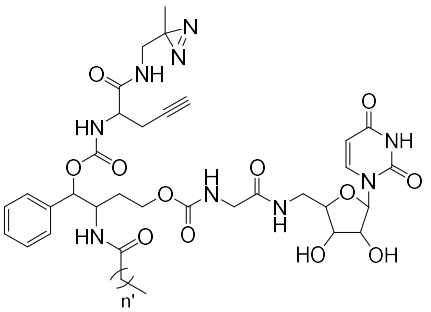
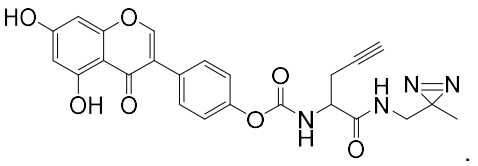


wherein n' is 0 to 50; or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19. An assay platform, comprising:

a substrate; and

a probe according to any one of claims 1-13, wherein the probe is covalently bound to the substrate.