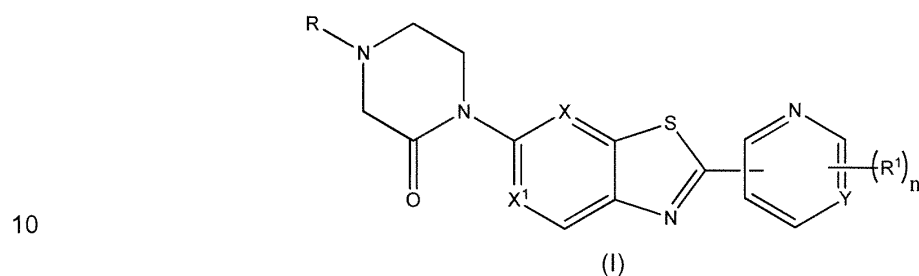


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CLAIMS

1. A compound of formula (I):

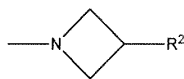
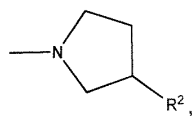
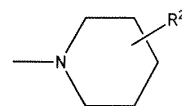


and detectably labeled derivatives, stereoisomers, racemic mixtures, pharmaceutically acceptable salts, hydrates, solvates, prodrugs and polymorphs thereof;

15 wherein

R is selected from the group consisting of hydrogen and alkyl;

R¹ is independently selected from the group consisting of fluorine,



and -NR³R⁴;

20

R² is selected from the group consisting of fluorine and hydrogen;

R³ and **R**⁴ are independently selected from the group consisting of alkyl, fluoro-alkyl, alkyl-O-alkyl and hydrogen;

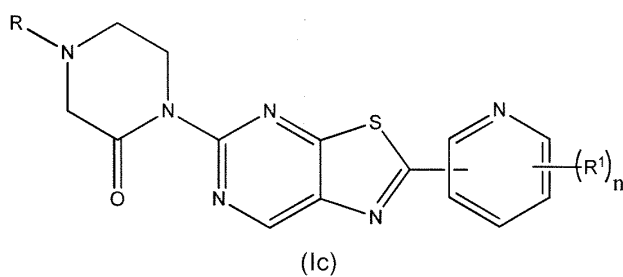
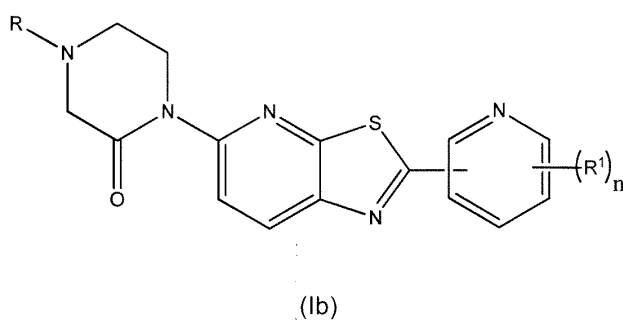
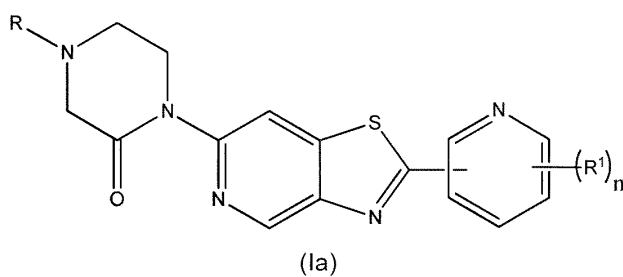
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X and **X**¹ are independently selected from the group consisting of N and CH, provided that at least one of **X** and **X**¹ is N;

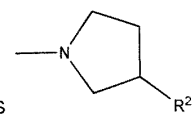
Y is independently selected from the group consisting of N and CH or **Y** is C if **Y** is attached to **R**¹;

n is 1 or 2.

2. The compound according to claim 1, which is a compound of the formula (Ia), (Ib) or (Ic):



wherein **R**, **R**¹ and **n** are as defined in claim 1.



3. The compound according to any one of claims 1 and 2, wherein R^1 is
4. The compound according to any one of claims 1 to 3, wherein at least one of R^1 , R^2 , R^3 and R^4 contains fluorine.
- 5
5. The compound according to any one of claims 1 to 4, wherein the compound is detectably labeled, preferably with ^2H , ^3H , ^{18}F or ^{13}N , more preferably with ^{18}F .
6. A diagnostic composition comprising a compound according to any one of claims 1 to 5 and optionally a pharmaceutically acceptable carrier, diluent, adjuvant and/or excipient.
- 10
7. The compound according to any one of claims 1 to 5 for use in diagnostics.
8. The compound according to any one of claims 1 to 5 for use in the imaging of alpha-synuclein aggregates including, but not limited to, Lewy bodies and/or Lewy neurites.
- 15
9. The compound for use according to claim 8, wherein the compound is for use in the positron emission tomography imaging of alpha-synuclein aggregates including, but not limited to, Lewy bodies and/or Lewy neurites.
- 20
10. The compound according to any one of claims 1 to 5 for use in the diagnostics of a disorder or abnormality associated with alpha-synuclein aggregates including, but not limited to, Lewy bodies and/or Lewy neurites or a preclinical state thereof.
- 25
11. The compound for use according to claim 10, wherein the disorder is selected from Parkinson's disease (including sporadic, familial with alpha-synuclein mutations, familial with mutations other than alpha-synuclein, pure autonomic failure or Lewy body dysphagia), dementia with Lewy bodies (including "pure" Lewy body dementia), sporadic Alzheimer's disease, familial Alzheimer's disease with APP mutations, familial Alzheimer's disease with PS-1, PS-2 or other mutations, familial British dementia, Lewy body variant of Alzheimer's disease, Down syndrome, multiple system atrophy (including Shy-Drager syndrome, striatonigral degeneration or olivopontocerebellar atrophy), traumatic brain
- 30

- injury, chronic traumatic encephalopathy, motor neuron disease, neuroaxonal dystrophy, neurodegeneration with brain iron accumulation type 1 (including Hallervorden-Spatz syndrome), prion diseases, ataxia telangiectatica, Meige's syndrome, subacute sclerosing panencephalitis, Gaucher disease, lysosomal storage disorders (including Kufor-Rakeb syndrome and Sanfilippo syndrome) and rapid eye movement (REM) sleep behavior disorder.
12. The compound for use according to claim 10, wherein the disorder is Parkinson's disease.
13. The compound for use according to claim 10, wherein the disorder is dementia with Lewy bodies.
14. The compound for use according to claim 10, wherein the disorder is multiple system atrophy.
15. A method of imaging of alpha-synuclein aggregates including, but not limited to, Lewy bodies and/or Lewy neurites, wherein an diagnostically effective amount of a compound according to any one of claims 1 to 5 is administered to a patient in need thereof.
16. The method according to claim 15, wherein the method is positron emission tomography imaging of alpha-synuclein aggregates including, but not limited to, Lewy bodies and/or Lewy neurites.
17. A method of diagnosing a disorder or abnormality associated with alpha-synuclein aggregates including, but not limited to, Lewy bodies and/or Lewy neurites, or a preclinical state thereof in a subject, wherein a diagnostically effective amount of a compound according to any one of claims 1 to 5 is administered to a patient in need thereof.
18. The method according to claim 17, wherein the disorder is selected from Parkinson's disease (including sporadic, familial with alpha-synuclein mutations, familial with mutations other than alpha-synuclein, pure autonomic failure or Lewy body dysphagia), dementia with Lewy bodies (including "pure" Lewy body dementia), sporadic Alzheimer's disease, familial Alzheimer's disease with APP mutations, familial Alzheimer's disease with PS-1, PS-2 or other mutations, familial British dementia, Lewy body variant of Alzheimer's

- disease, Down syndrome, multiple system atrophy (including Shy-Drager syndrome, striatonigral degeneration or olivopontocerebellar atrophy), traumatic brain injury, chronic traumatic encephalopathy, motor neuron disease, neuroaxonal dystrophy, neurodegeneration with brain iron accumulation type 1 (including Hallervorden-Spatz syndrome), prion diseases, ataxia telangiectatica, Meige's syndrome, subacute sclerosing panencephalitis, Gaucher disease, lysosomal storage disorders (including Kufor-Rakeb syndrome and Sanfilippo syndrome) and rapid eye movement (REM) sleep behavior disorder.
19. The method according to claim 17, wherein the disorder is Parkinson's disease.
20. The method according to claim 17, wherein the disorder is dementia with Lewy bodies.
21. The method according to claim 17, wherein the disorder is multiple system atrophy.
22. A method of collecting data for the diagnosis of a disorder or abnormality associated with alpha-synuclein aggregates in a patient comprising:
- (a) bringing a sample or specific body part or body area of the patient suspected to contain alpha-synuclein aggregates into contact with a compound as defined in any one of claims 1 to 5;
 - (b) allowing the compound to bind to the alpha-synuclein aggregates;
 - (c) detecting the compound bound to the alpha-synuclein aggregates; and
 - (d) optionally correlating the presence or absence of compound binding with the alpha-synuclein aggregates with the presence or absence of alpha-synuclein aggregates in the sample or specific body part or body area.
23. A method of collecting data for diagnosis of the preclinical state of a disorder or abnormality associated with alpha-synuclein aggregates in a patient comprising detecting the specific binding of a compound as defined in any one of claims 1 to 5 to alpha-synuclein aggregates in a sample or specific body part or body area of the patient which comprises the steps of:
- (a) bringing the sample or specific body part or body area suspected to contain the alpha-synuclein aggregates into contact with the compound as defined in any one of items 1 to 5, which compound specifically binds to the alpha-synuclein aggregates;

- (b) allowing the compound to bind to the alpha-synuclein aggregates to form a compound/(alpha-synuclein aggregate) complex;
- (c) detecting the formation of the compound/(alpha-synuclein aggregate) complex;
- 5 (d) optionally correlating the presence or absence of the compound/(alpha-synuclein aggregate) complex with the presence or absence of alpha-synuclein aggregates in the sample or specific body part or body area; and
- (e) optionally comparing the amount of the compound/(alpha-synuclein aggregate) complex to a normal control value.
- 10 24. A method of collecting data for monitoring residual disorder in a patient suffering from a disorder or abnormality associated with alpha-synuclein aggregates who has been treated with a medicament, wherein the method comprises:
- (a) bringing a sample or specific body part or body area suspected to contain alpha-synuclein aggregates into contact with a compound as defined in any one of claims
- 15 1 to 5, which compound specifically binds to the alpha-synuclein aggregates;
- (b) allowing the compound to bind to the alpha-synuclein aggregates to form a compound/(alpha-synuclein aggregate) complex;
- (c) detecting the formation of the compound/(alpha-synuclein aggregate) complex;
- 20 (d) optionally correlating the presence or absence of the compound/(alpha-synuclein aggregate) complex with the presence or absence of alpha-synuclein aggregate in the sample or specific body part or body area; and
- (e) optionally comparing the amount of the compound/(alpha-synuclein aggregate) complex to a normal control value.
- 25 25. The method according to claim 24, wherein step (d) is present and wherein the method further comprises steps (i) to (vi) before step (a):
- (i) bringing a sample or specific body part or body area suspected to contain alpha-synuclein aggregates into contact with the compound as defined in any one of items
- 30 1 to 5, which compound specifically binds to the alpha-synuclein aggregates;
- (ii) allowing the compound to bind to the alpha-synuclein aggregates to form a compound/(alpha-synuclein aggregate) complex;
- (iii) detecting the formation of the compound/(alpha-synuclein aggregate) complex;

- (iv) correlating the presence or absence of the compound/(alpha-synuclein aggregate) complex with the presence or absence of alpha-synuclein aggregates in the sample or specific body part or body area;
- (v) optionally comparing the amount of the compound/(alpha-synuclein aggregate) complex to a normal control value; and
- (vi) treating the patient with the medicament;
- and wherein the method further comprises step (A) after step (d) or step (e):
- (A) comparing the amount of the compound/(alpha-synuclein aggregate) complex determined in step (iv) to the amount of the compound/(alpha-synuclein aggregate) complex determined in step (d).
26. The method according to claim 24 or 25, wherein steps (a) to (c) and optionally steps (d) and (e) are repeated one or more times.
27. A method of collecting data for predicting responsiveness of a patient suffering from a disorder or abnormality associated with alpha-synuclein aggregates and being treated with a medicament comprising:
- (a) bringing a sample or specific body part or body area suspected to contain alpha-synuclein aggregates into contact with a compound as defined in any one of claims 1 to 5, which compound specifically binds to the alpha-synuclein aggregates;
- (b) allowing the compound to bind to the alpha-synuclein aggregates to form a compound/(alpha-synuclein aggregate) complex;
- (c) detecting the formation of the compound/(alpha-synuclein aggregate) complex;
- (d) optionally correlating the presence or absence of the compound/(alpha-synuclein aggregate) complex with the presence or absence of alpha-synuclein aggregates in the sample or specific body part or body area; and
- (e) optionally comparing the amount of the compound/(alpha-synuclein aggregate) complex to a normal control value.
28. The method according to claim 27, wherein step (d) is present and wherein the method further comprises steps (i) to (vi) before step (a):
- (i) bringing a sample or specific body part or body area suspected to contain alpha-synuclein aggregates into contact with the compound as defined in any one of items 1 to 5, which compound specifically binds to the alpha-synuclein aggregates;

- (ii) allowing the compound to bind to the alpha-synuclein aggregates to form a compound/(alpha-synuclein aggregate) complex;
- (iii) detecting the formation of the compound/(alpha-synuclein aggregate) complex;
- 5 (iv) correlating the presence or absence of the compound/(alpha-synuclein aggregate) complex with the presence or absence of alpha-synuclein aggregates in the sample or specific body part or body area;
- (v) optionally comparing the amount of the compound/(alpha-synuclein aggregate) complex to a normal control value; and
- (vi) treating the patient with the medicament;
- 10 and wherein the method further comprises step (A) after step (d) or step (e):
- (A) comparing the amount of the compound/(alpha-synuclein aggregate) complex determined in step (iv) to the amount of the compound/(alpha-synuclein aggregate) complex determined in step (d).
- 15 29. The method according to claim 27 or 28, wherein steps (a) to (c) and optionally steps (d) and (e) are repeated one or more times.
30. A method of diagnosing a disorder or abnormality associated with alpha-synuclein aggregates in a patient comprising:
- 20 (a) bringing a sample or specific body part or body area of the patient suspected to contain alpha-synuclein aggregates into contact with a compound as defined in any one of claims 1 to 5;
- (b) allowing the compound to bind to the alpha-synuclein aggregates;
- (c) detecting the compound bound to the alpha-synuclein aggregates; and
- 25 (d) optionally correlating the presence or absence of compound binding with the alpha-synuclein aggregates with the presence or absence of alpha-synuclein aggregates in the sample or specific body part or body area.
31. A method of diagnosis the preclinical state of a disorder or abnormality associated with
- 30 alpha-synuclein aggregates in a patient comprising detecting the specific binding of a compound as defined in any one of claims 1 to 5 to alpha-synuclein aggregates in a sample or specific body part or body area of the patient which comprises the steps of:

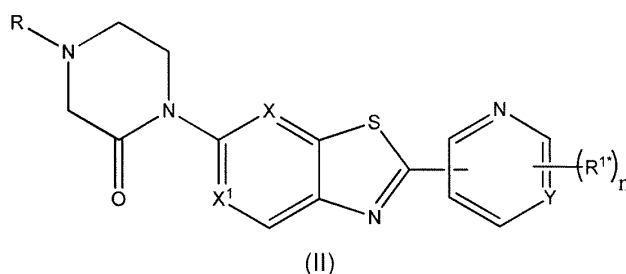
- 5 (a) bringing the sample or specific body part or body area suspected to contain the alpha-synuclein aggregates into contact with the compound as defined in any one of claims 1 to 5, which compound specifically binds to the alpha-synuclein aggregates;
- (b) allowing the compound to bind to the alpha-synuclein aggregates to form a compound/(alpha-synuclein aggregate) complex;
- (c) detecting the formation of the compound/(alpha-synuclein aggregate) complex;
- (d) optionally correlating the presence or absence of the compound/(alpha-synuclein aggregate) complex with the presence or absence of alpha-synuclein aggregates in the sample or specific body part or body area; and
- 10 (e) optionally comparing the amount of the compound/(alpha-synuclein aggregate) complex to a normal control value.
32. A method of monitoring residual disorder in a patient suffering from a disorder or abnormality associated with alpha-synuclein aggregates who has been treated with a medicament, wherein the method comprises:
- 15 (a) bringing a sample or specific body part or body area suspected to contain alpha-synuclein aggregates into contact with a compound as defined in any one of claims 1 to 5, which compound specifically binds to the alpha-synuclein aggregates;
- (b) allowing the compound to bind to the alpha-synuclein aggregates to form a compound/(alpha-synuclein aggregate) complex;
- 20 (c) detecting the formation of the compound/(alpha-synuclein aggregate) complex;
- (d) optionally correlating the presence or absence of the compound/(alpha-synuclein aggregate) complex with the presence or absence of alpha-synuclein aggregates in the sample or specific body part or body area; and
- 25 (e) optionally comparing the amount of the compound/(alpha-synuclein aggregate) complex to a normal control value.
33. The method according to claim 32, wherein step (d) is present and wherein the method further comprises steps (i) to (vi) before step (a):
- 30 (i) bringing a sample or specific body part or body area suspected to contain alpha-synuclein aggregates into contact with the compound as defined in any one of items 1 to 5, which compound specifically binds to the alpha-synuclein aggregates;
- (ii) allowing the compound to bind to the alpha-synuclein aggregates to form a compound/(alpha-synuclein aggregate) complex;

- (iii) detecting the formation of the compound/(alpha-synuclein aggregate) complex;
- (iv) correlating the presence or absence of the compound/(alpha-synuclein aggregate) complex with the presence or absence of alpha-synuclein aggregates in the sample or specific body part or body area;
- 5 (v) optionally comparing the amount of the compound/(alpha-synuclein aggregate) complex to a normal control value; and
- (vi) treating the patient with the medicament;
- and wherein the method further comprises step (A) after step (d) or step (e):
- (A) comparing the amount of the compound/(alpha-synuclein aggregate) complex
- 10 determined in step (iv) to the amount of the compound/(alpha-synuclein aggregate) complex determined in step (d).
34. The method according to claim 32 or 33, wherein steps (a) to (c) and optionally steps (d) and (e) are repeated one or more times.
- 15
35. A method of predicting responsiveness of a patient suffering from a disorder or abnormality associated with alpha-synuclein aggregates and being treated with a medicament comprising:
- (a) bringing a sample or specific body part or body area suspected to contain alpha-synuclein aggregates into contact with a compound as defined in any one of claims
- 20 1 to 5, which compound specifically binds to the alpha-synuclein aggregates;
- (b) allowing the compound to bind to the alpha-synuclein aggregates to form a compound/(alpha-synuclein aggregate) complex;
- (c) detecting the formation of the compound/(alpha-synuclein aggregate) complex;
- 25 (d) optionally correlating the presence or absence of the compound/(alpha-synuclein aggregate) complex with the presence or absence of alpha-synuclein aggregates in the sample or specific body part or body area; and
- (e) optionally comparing the amount of the compound/(alpha-synuclein aggregate) complex to a normal control value.
- 30
36. The method according to claim 35, wherein step (d) is present and wherein the method further comprises steps (i) to (vi) before step (a):

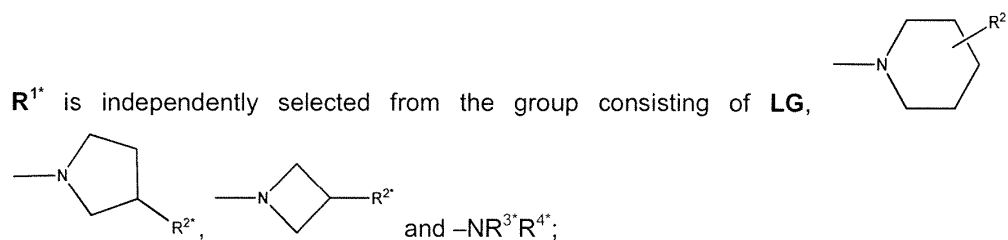
- (i) bringing a sample or specific body part or body area suspected to contain alpha-synuclein aggregates into contact with the compound as defined in any one of claims 1 to 5, which compound specifically binds to the alpha-synuclein aggregates;
- (ii) allowing the compound to bind to the alpha-synuclein aggregates to form a compound/(alpha-synuclein aggregate) complex;
- (iii) detecting the formation of the compound/(alpha-synuclein aggregate) complex;
- (iv) correlating the presence or absence of the compound/(alpha-synuclein aggregate) complex with the presence or absence of alpha-synuclein aggregates in the sample or specific body part or body area;
- (v) optionally comparing the amount of the compound/(alpha-synuclein aggregate) complex to a normal control value; and
- (vi) treating the patient with the medicament;
- and wherein the method further comprises step (A) after step (d) or step (e):
- (A) comparing the amount of the compound/(alpha-synuclein aggregate) complex determined in step (iv) to the amount of the compound/(alpha-synuclein aggregate) complex determined in step (d).
37. The method according to claim 35 or 36, wherein steps (a) to (c) and optionally steps (d) and (e) are repeated one or more times.
38. The method according to any one of claims 22 to 37, wherein the disorder is selected from Parkinson's disease (including sporadic, familial with alpha-synuclein mutations, familial with mutations other than alpha-synuclein, pure autonomic failure or Lewy body dysphagia), dementia with Lewy bodies (including "pure" Lewy body dementia), sporadic Alzheimer's disease, familial Alzheimer's disease with APP mutations, familial Alzheimer's disease with PS-1, PS-2 or other mutations, familial British dementia, Lewy body variant of Alzheimer's disease, Down syndrome, multiple system atrophy (including Shy-Drager syndrome, striatonigral degeneration or olivopontocerebellar atrophy), traumatic brain injury, chronic traumatic encephalopathy, motor neuron disease, neuroaxonal dystrophy, neurodegeneration with brain iron accumulation type 1 (including Hallervorden-Spatz syndrome), prion diseases, ataxia telangiectatica, Meige's syndrome, subacute sclerosing panencephalitis, Gaucher disease, lysosomal storage disorders (including Kufor-Rakeb syndrome and Sanfilippo syndrome) and rapid eye movement (REM) sleep behavior disorder.

39. The method according to any one of claims 22 to 37, wherein the disorder is Parkinson's disease.
- 5 40. The method according to any one of claims 22 to 37, wherein the disorder is dementia with Lewy bodies.
41. The method according to any one of claims 22 to 37, wherein the disorder is multiple system atrophy.
- 10 42. A method of determining the amount of alpha-synuclein aggregates in a sample or specific body part or body area of a patient comprising:
- 15 (a) providing the sample or specific body part or body area;
- (b) testing the sample or specific body part or body area for the presence of alpha-synuclein aggregates with a compound as defined in any one of claims 1 to 5;
- (c) determining the amount of compound bound to the alpha-synuclein aggregates; and
- (d) calculating the amount of alpha-synuclein aggregates in the sample or specific body part or body area.
- 20 43. The method according to any one of claims 22 to 37, wherein the method is applied to a sample or specific body part obtained from a patient.
44. The method according to any one of claims 22 to 43, wherein the sample is a tissue and/or a body fluid representative of the specific body part or body area under
- 25 investigation.
45. The method according to any one of claims 22 to 44, wherein alpha-synuclein aggregates include Lewy bodies and/or Lewy neurites.
- 30 46. A mixture comprising a compound as defined in any one of claims 1 to 5 and at least one compound selected from an imaging agent different from the compound as defined in any one of claims 1 to 5, preferably an abeta or Tau imaging agent, a pharmaceutically acceptable carrier, a diluent and an excipient.

47. A compound of formula (II)



wherein **R**, **X**, **X¹**, **Y** and **n** are as defined in claim 1;



wherein

R^{2*} is selected from the group consisting of **LG** and hydrogen;

R^{3*} and **R^{4*}** are independently selected from the group consisting of alkyl, **LG**–alkyl, alkyl–O–alkyl, **PG** and hydrogen;

LG is a leaving group; and

PG is an amino protecting group,

wherein at least one of **R^{1*}**, **R^{2*}**, **R^{3*}** and **R^{4*}** contains **LG**.

48. The compound according to claim 47, wherein **LG** is selected from halogen, trimethylammonium, C_{1–4} alkyl sulfonate or C_{6–10} aryl sulfonate.

49. The compound according to claim 48, wherein **LG** is selected from the group consisting of mesylate, triflate, tosylate and nosylate.
50. A method for preparing the compound according to claim 5, wherein the compound is labelled by ^{18}F , comprising reacting the compound according to claim 11 with a ^{18}F -fluorinating agent, so that **LG** is replaced by ^{18}F .
51. The method according to claim 50, wherein the ^{18}F -fluorinating agent is selected from K^{18}F , H^{18}F , Cs^{18}F , Na^{18}F and tetrabutylammonium [^{18}F]fluoride.
52. Use of the compound according to any one of claims 1 to 5 as an *in vitro* analytical reference or an *in vitro* screening tool.
53. A test kit for use in the detection and/or diagnosis of a disorder or abnormality associated with alpha-synuclein aggregates including, but not limited to, Lewy bodies and/or Lewy neurites, wherein the test kit comprises at least one compound as defined in any one of claims 1 to 5.
54. The test kit for use according to claim 53 comprising a container containing at least one compound as defined in any one of claims 1 to 5 and instructions for using the at least one compound for the purpose of binding to alpha-synuclein aggregates including, but not limited to, Lewy bodies and/or Lewy neurites to form a compound/(alpha-synuclein aggregate including, but not limited to, Lewy bodies and/or Lewy neurites) complex and detecting the formation of the compound/(alpha-synuclein aggregate including, but not limited to, Lewy bodies and/or Lewy neurites) complex such that presence or absence of the compound/(alpha-synuclein aggregate including, but not limited to, Lewy bodies and/or Lewy neurites) complex correlates with the presence or absence of the alpha-synuclein aggregates including, but not limited to, Lewy bodies and/or Lewy neurites.
55. A kit for preparing a radiopharmaceutical preparation, wherein the kit comprises a sealed vial containing at least one compound as defined in claim 47.