14. The crystalline Form II of claim 9, characterized by an x-ray powder diffraction pattern further having peaks expressed as 2θ at 4.48, 9.00, 13.58, 15.62, 16.48, 19.02, 19.44, 22.46 and 25.00 ± 0.2 degrees when measured against an internal silicon standard.

15. A pharmaceutical composition comprising the crystalline form of any of claims 1 to 7.

16. A pharmaceutical composition comprising the crystalline form of any of claims 8 to 14.

17. The crystalline form of any of claims 1 to 7 for the treatment and/or prophylaxis of a disease which can be treated or prevented by alpha-7 receptor activation.

18. The crystalline form of any of claims 8 to 14 for the treatment and/or prophylaxis of a disease which can be treated or prevented by alpha-7 receptor activation.

~~19. A method of treating or preventing a disease which can be treated or prevented by alpha-7 receptor activation comprising administering to a subject the crystalline form of any of claims 1 to 7.~~

~~20. A method of treating or preventing a disease which can be treated or prevented by alpha-7 receptor activation comprising administering to a subject the crystalline form of any of claims 8 to 14.~~

~~21~~19. ~~A method~~Use of the crystalline form of any of claims 1 to 7 for the manufacture of a medicament for improving cognition or treating cognitive loss in a subject ~~comprising administering to a subject the crystalline form of any of claims 1 to 7~~.

~~22~~20. The ~~method~~ use of claim ~~21~~ 19 wherein the subject is suffering from a disorder selected from: attention deficit disorder, attention deficit hyperactivity disorder, and Parkinson's Disease.

~~23~~21. The ~~method~~ use of claim ~~21~~ 19 wherein the subject is suffering from a disorder selected from Alzheimer's Disease and schizophrenia.

~~2422~~. ~~A method of~~Use of the crystalline form of any of claims 1 to 7 for the manufacture of a medicament for treating a disorder selected from attention deficit disorder, attention deficit hyperactivity disorder, Parkinson's Disease, Alzheimer's Disease and schizophrenia~~, the method comprising administering to a subject the crystalline form of any of claims 1 to 7~~.

~~25. A method of treating a subject that is at risk for developing a disorder selected from: Alzheimer's disease, Parkinson's Disease and schizophrenia, the method comprising administering to the subject the crystalline form of any of claims 1 to 7.~~

~~26. A method of treating a subject over age 60, comprising administering to the subject the crystalline form of any of claims 1 to 7.~~

~~27. A method of treating a subject for age-related memory loss, comprising administering to the subject the crystalline form of any of claims 1 to 7.~~

~~28. The method of claim 27 wherein the subject is over age 60.~~

~~29~~23. A method for preparing a pharmaceutical composition, the method comprising combining the crystalline form of any of claims 1 to 7 with an excipient or pharmaceutically acceptable carrier.

~~30~~24. The method according to claim ~~29~~23, the method comprising combining the crystalline form of any of claims 1 to 7 with a liquid.

~~31~~25. A method for preparing a pharmaceutical composition, the method comprising filling a capsule with a composition comprising the crystalline form of any of claims 1 to 7.

~~32~~26. ~~A method~~Use of the crystalline form of any of claims 8 to 14 for the manufacture of a medicament for improving cognition or treating cognitive loss in a subject ~~comprising administering to a subject the crystalline form of any of claims 8 to 14~~.

~~33~~27. The ~~method~~ use of claim ~~32~~ 26 wherein the subject is suffering from a disorder selected from: attention deficit disorder, attention deficit hyperactivity disorder, and Parkinson's Disease.

~~34~~28. The ~~method~~ use of claim ~~32~~ 26 wherein the subject is suffering from a disorder selected from Alzheimer's Disease and schizophrenia.

~~35~~29. ~~A method of~~Use of the crystalline form of any of claims 8 to 14 for the manufacture of a medicament for treating a disorder selected from attention deficit disorder, attention deficit hyperactivity disorder, Parkinson's Disease, Alzheimer's Disease and schizophrenia~~,~~ ~~the method comprising administering to a subject the crystalline form of any of claims 8 to 14~~.

~~36. A method of treating a subject that is at risk for developing a disorder selected from: Alzheimer's disease, Parkinson's Disease and schizophrenia, the method comprising administering to the subject the crystalline form of any of claims 8 to 14.~~

~~37. A method of treating a subject over age 60, comprising administering to the subject the crystalline form of any of claims 8 to 14.~~

~~38. A method of treating a subject for age-related memory loss, comprising administering to the subject the crystalline form of any of claims 8 to 14.~~

~~39. The method of claim 38 wherein the subject is over age 60.~~

~~40~~30. A method for preparing a pharmaceutical composition, the method comprising combining the crystalline form of any of claims 8 to 14 with an excipient or pharmaceutically acceptable carrier.

~~41~~31. The method according to claim ~~40~~30, the method comprising combining the crystalline form of any of claims 8 to 14 with a liquid.

~~42~~32. A method for preparing a pharmaceutical composition, the method comprising filling a capsule with a composition comprising the crystalline form of any of claims 8 to 14.

~~43~~33. A method of manufacturing a crystalline Form I of any one of claims 1 to 7, which comprises:

(1) stirring (R)-7-chloro-N-(quinuclidin-3-yl)benzo[b]thiophene-2-carboxamide hydrochloride in an aqueous organic solvent within the temperature-water activity range I , if required with decreasing the temperature and/ or water activity thereof, to form a substantially pure crystalline Form I , and

(2) isolating the resulting crystalline Form I,

wherein the temperature-water activity range I is defined by the following relationship of the temperature and the water activity of the aqueous organic solvent,

the water activity (x) of the aqueous organic solvent is from 0.16 to 0.73 ; and

the temperature (T) of the aqueous organic solvent is higher than (183x - 64.2) and lower than the boiling temperature of the aqueous organic solvent.

4434. The method of claim 4333, wherein in step (1) the initial state of (R)-7-chloro-N-(quinuclidin-3-yl)benzo[b]thiophene-2-carboxamide hydrochloride in an aqueous organic solvent is a solution, and the solution is stirred within the temperature-water activity range I with decreasing the temperature and/ or water activity thereof.

4535. The method of claim 4333, wherein in step (1) the initial state of (R)-7-chloro-N-(quinuclidin-3-yl)benzo[b]thiophene-2-carboxamide hydrochloride in an aqueous organic solvent is a suspension, and the suspension is stirred within the temperature-water activity range I, if required with decreasing the temperature and/ or water activity thereof.

4636. The method of claim 44 34 wherein in step (1) the seed crystals of (R)-7-chloro-N-(quinuclidin-3-yl)benzo[b]thiophene-2-carboxamide hydrochloride is added to the solution.

4737. The method of claim 46 36 wherein the seed crystals are Form I of (R)-7-chloro-N-(quinuclidin-3-yl)benzo[b]thiophene-2-carboxamide hydrochloride monohydrate.

4838. The method of any of claims 43 33 to 4737, wherein the water activity is from 0.29 to 0.59.

4939. The method of claim 4333, wherein the temperature is between -10 °C and 60 °C and higher than the following T:

$$T = 183x - 57.6$$

wherein x is water activity of the aqueous organic solvent and T is a temperature (°C).

5040. The method of claim 4939, wherein the end point temperature in step (1) is between 0 °C and 35 °C.

~~51~~41. The method of claim ~~43~~33, wherein the aqueous organic solvent is mixture of water and one or more of organic solvents which are miscible with water and are selected from alcohols, ketones, nitriles and ethers.

~~52~~42. The method of claim ~~43~~33, wherein the aqueous organic solvent is mixture of water and one or more of organic solvents which are miscible with water and are selected from propanol, butanol, butanone and acetonitrile.

~~53~~43. A method of manufacturing a crystalline Form II of any one of claims 8 to 14, which comprises:

(1) stirring (R)-7-chloro-N-(quinuclidin-3-yl)benzo[b]thiophene-2-carboxamide hydrochloride in an aqueous organic solvent within the temperature-water activity range II , if required with decreasing the temperature and/ or water activity thereof, to form a crystalline Form II , and

(2) isolating the resulting crystalline Form II,

wherein the temperature-water activity range II is defined by the following relationship of the temperature and the water activity of the aqueous organic solvent,

the water activity (x) of the aqueous organic solvent is from 0.16 to 0.73 ; and

the temperature (T) of the aqueous organic solvent is lower than (183x - 64.2) and higher than the freezing-point temperature of the aqueous organic solvent.

~~54~~44. The method of claim ~~53~~43, wherein in step (1) the initial state of (R)-7-chloro-N-(quinuclidin-3-yl)benzo[b]thiophene-2-carboxamide hydrochloride in an aqueous organic solvent is a solution, and the solution is stirred within the temperature-water activity range II with decreasing the temperature and/ or water activity thereof.

~~55~~45. The method of claim ~~53~~43, wherein in step (1) the initial state of (R)-7-chloro-N-(quinuclidin-3-yl)benzo[b]thiophene-2-carboxamide hydrochloride in an aqueous organic solvent is a suspension, and the suspension is stirred within the temperature-water activity range II, optionally decreasing the temperature and/ or water activity thereof.

~~56~~46. The method of claim ~~54~~44 wherein in step (1) the seed crystals of (R)-7-chloro-N-(quinuclidin-3-yl)benzo[b]thiophene-2-carboxamide hydrochloride is added to the solution.

~~57~~47. The method of claim ~~56~~ 46 wherein the seed crystals are Form II of (R)-7-chloro-N-(quinuclidin-3-yl)benzo[b]thiophene-2-carboxamide hydrochloride monohydrate.

~~58~~48. The method of any of claims ~~53~~ 43 to ~~57~~47, wherein the water activity is from 0.29 to 0.59.

~~59~~49. The method of claim ~~53~~43, wherein the temperature is between -10 °C and 60 °C and lower than the following T:

$$T = 183x - 70.8$$

wherein x is water activity of the aqueous organic solvent and T is a temperature (°C).

~~60~~50. The method of claim ~~59~~49, wherein the end point temperature in step (1) is between 0 °C and 35 °C.

~~61~~51. The method of claim ~~53~~43, wherein the aqueous organic solvent is mixture of water and one or more of organic solvents which are miscible with water and are selected from alcohols, ketones, nitriles and ethers.

~~62~~52. The method of claim ~~53~~43, wherein the aqueous organic solvent is mixture of water and one or more of organic solvents which are miscible with water and are selected from propanol, butanol, butanone and acetonitrile.

~~63~~53. A method for preparing the crystalline Form I of claim 1, the method comprising:

(a) heating 10 – 30% by weight of (R)-7-chloro-N-(quinuclidin-3-yl)benzo[b]thiophene-2-carboxamide hydrochloride in acetonitrile or an aqueous acetonitrile to between 60°C and the boiling point of the solution

(b) optionally adding water to the mixture to fully dissolve the (R)-7-chloro-N-(quinuclidin-3-yl)benzo[b]thiophene-2-carboxamide hydrochloride;

(c) cooling the solution until crystals are just visible;

(d) if the water content is greater than 3% volume/volume when crystals are just visible, adding acetonitrile to the mixture so that the water content is less than 3% volume/volume;

(e) cooling the resulting mixture to below 15 ° C; and

(f) isolating crystalline (R)-7-chloro-N-(quinuclidin-3-yl)benzo[b]thiophene-2-carboxamide hydrochloride monohydrate.

6454. The method of claim 63-53 wherein the water added in step (a) does not bring the water content of the mixture above 30% volume/volume.

6555. The method of Claim 63-53 wherein (R)-7-chloro-N-(quinuclidin-3-yl)benzo[b]thiophene-2-carboxamide hydrochloride is present at 15-25% by weight in step (a).

6656. The method of claim 63-53 wherein (R)-7-chloro-N-(quinuclidin-3-yl)benzo[b]thiophene-2-carboxamide hydrochloride is present at 16-20% by weight in step (a).

6757. The method of Claim 63-53 wherein (R)-7-chloro-N-(quinuclidin-3-yl)benzo[b]thiophene-2-carboxamide hydrochloride is present at 17-19% by weight in step (a).

6858. The method of claim 63-53 further comprising adding Form I (R)-7-chloro-N-(quinuclidin-3-yl)benzo[b]thiophene-2-carboxamide hydrochloride monohydrate to the mixture after crystals are just visible.

6959. The method of claim 63-53 wherein step (c) comprises cooling the solution to below 55°C.

7060. The method of claim 63-53 wherein step (c) comprises cooling the solution to below 50°C.

7161. A method for preparing the crystalline Form II of claim 8, the method comprising:

(a) heating 5 – 15 % by weight of (R)-7-chloro-N-(quinuclidin-3-yl)benzo[b]thiophene-2-carboxamide hydrochloride in 2-butanol or an aqueous 2-butanol to between 60°C and the boiling point of the solution;

(b) if the water content is less than 5% volume/volume, adding water to the mixture so that the water content is not less than 5% volume/volume;

(c) cooling the solution to below 10°C;

(d) keeping the resulting mixture at below 10° C; and

(e) isolating crystalline (R)-7-chloro-N-(quinuclidin-3-yl)benzo[b]thiophene-2-carboxamide hydrochloride monohydrate.

~~72~~62. A method for preparing the crystalline Form II of claim 8, the method comprising:

(a) adding (R)-7-chloro-N-(quinuclidin-3-yl)benzo[b]thiophene-2-carboxamide hydrochloride to (i) acetonitrile or (ii) aqueous acetonitrile to create a composition that is 10-20% by weight of (R)-7-chloro-N-(quinuclidin-3-yl)benzo[b]thiophene-2-carboxamide hydrochloride;

(b) optionally adding water to the composition to make the water content 6-10%;

(c) optionally cooling the solution at below 10°C;

(d) allowing crystals to form; and

(e) isolating crystalline (R)-7-chloro-N-(quinuclidin-3-yl)benzo[b]thiophene-2-carboxamide hydrochloride monohydrate.