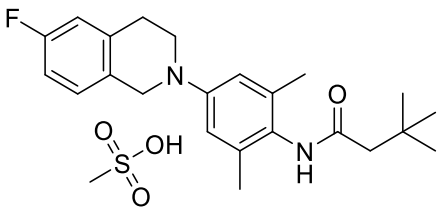
CLAIMS

1. A mesylate salt crystal form A of a compound of formula I, wherein the mesylate salt crystal form A has an X-ray powder diffraction pattern, obtained using Cu-Kα radiation and expressed in 2θ angles, comprising diffraction peaks at the following positions: 5.60°±0.2°, 12.31°±0.2°, and 15.40°±0.2°;



structural formula of mesylate salt of compound of formula I.

2. The mesylate salt crystal form A according to claim 1, wherein the X-ray powder diffraction pattern of the mesylate salt crystal form A, expressed in 2θ angles, further comprises diffraction peaks at one or more of the following positions: 9.47°±0.2°, 10.99°±0.2°, 17.57°±0.2°, and 19.15°±0.2°;

preferably, the X-ray powder diffraction pattern further comprises diffraction peaks at one or more of the following positions: 14.86°±0.2°, 17.12°±0.2°, 18.33°±0.2°, 22.42°±0.2°, and 22.94°±0.2°;

more preferably, the X-ray powder diffraction pattern further comprises diffraction peaks at one or more of the following positions: 7.35°±0.2°, 11.36°±0.2°, 19.66°±0.2°, 20.10°±0.2°, 21.78°±0.2°, 26.69°±0.2°, and 28.95°±0.2°.

3. The mesylate salt crystal form A according to claim 1, wherein the X-ray powder diffraction pattern of the mesylate salt crystal form A, expressed in 2θ angles, comprises diffraction peaks as shown in the following table:

Diffraction angle [°2θ]	d-Spacing [Å]
5.60	15.76
7.35	12.02
9.47	9.34
10.99	8.05
11.36	7.78
12.31	7.18
13.48	6.56
14.02	6.31
14.86	5.96
15.40	5.75
16.45	5.39
17.12	5.18
17.57	5.04
18.33	4.84
19.15	4.63
19.66	4.51
20.10	4.41

20.66	4.29
21.78	4.08
22.42	3.96
22.94	3.87

;

preferably, the X-ray powder diffraction pattern of the mesylate salt crystal form A, expressed in 2θ angles, comprises diffraction peaks as shown in the following table:

Diffraction angle [°2θ]	d-Spacing [Å]	Relative intensity [%]
5.60	15.76	100.00
7.35	12.02	5.52
9.47	9.34	15.75
10.99	8.05	15.18
11.36	7.78	5.25
12.31	7.18	30.38
13.48	6.56	2.22
14.02	6.31	2.03
14.86	5.96	7.19
15.40	5.75	42.13
16.45	5.39	2.22
17.12	5.18	6.96

17.57	5.04	12.61
18.33	4.84	8.44
19.15	4.63	13.26
19.66	4.51	4.53
20.10	4.41	5.51
20.66	4.29	2.95
21.78	4.08	3.66
22.42	3.96	9.95
22.94	3.87	7.28
23.44	3.79	2.46
26.69	3.34	3.46
27.18	3.28	2.42
28.95	3.08	3.45
34.31	2.61	2.69
36.14	2.48	1.33

;

more preferably, the X-ray powder diffraction pattern of the mesylate salt crystal form A, expressed in 2θ angles, is substantially as shown in FIG. 3.

4. The mesylate salt crystal form A according to any one of claims 1 to 3, wherein one or more of the following conditions are met:

(1) the mesylate salt crystal form A has a differential scanning calorimetry thermogram comprising an endothermic peak at a peak temperature of 213.85°C±3°C;

preferably, the differential scanning calorimetry thermogram of the mesylate salt crystal form A comprises an endothermic peak at a peak temperature of 213.85°C±3°C, with a heat of fusion of 66.99 J/g;

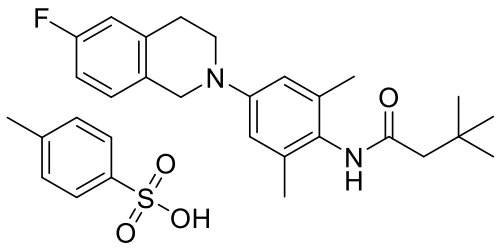
more preferably, the differential scanning calorimetry thermogram of the mesylate salt crystal form A is substantially as shown in FIG. 2;

(2) the mesylate salt crystal form A has a thermogravimetric analysis thermogram showing a weight loss of 0.85% upon heating to 180°C;

preferably, the thermogravimetric analysis thermogram of the mesylate salt crystal form A is substantially as shown in FIG. 2;

and (3) the mesylate salt crystal form A is an anhydrous crystal form of a monomesylate salt.

5. A tosylate salt crystal form B of a compound of formula I, wherein the tosylate salt crystal form B has an X-ray powder diffraction pattern, obtained using Cu-Kα radiation and expressed in 2θ angles, comprising diffraction peaks at the following positions: 13.44°±0.2°, 17.28°±0.2°, and 17.38°±0.2°;



structural formula of tosylate salt of compound of formula I.

6. The tosylate salt crystal form B according to claim 5, wherein the X-ray powder diffraction pattern of the tosylate salt crystal form B, expressed in 2θ angles, further comprises diffraction peaks at one or more of the following positions: 5.64°±0.2°, 14.49°±0.2°, 15.13°±0.2°, 20.45°±0.2°, 21.15°±0.2°, and 22.15°±0.2°;

preferably, the X-ray powder diffraction pattern further comprises diffraction peaks at one or more of the following positions: 7.84°±0.2°, 10.11°±0.2°, 11.36°±0.2°, 12.03°±0.2°, 13.60°±0.2°, 18.58°±0.2°, and 23.97°±0.2°;

more preferably, the X-ray powder diffraction pattern further comprises diffraction peaks at one or more of the following positions: 5.09°±0.2°, 9.22°±0.2°, 10.87°±0.2°, 16.21°±0.2°, 19.55°±0.2°, 22.89°±0.2°, 25.03°±0.2°, and 27.08°±0.2°.

7. The tosylate salt crystal form B according to claim 5, wherein the X-ray powder diffraction pattern of the tosylate salt crystal form B, expressed in 2θ angles, comprises diffraction peaks as shown in the following table:

Diffraction angle [°2θ]	d-Spacing [Å]
5.09	17.34
5.64	15.66
7.06	12.51
7.84	11.26

9.22	9.59
10.11	8.74
10.87	8.13
11.36	7.78
12.03	7.35
13.44	6.58
13.60	6.51
14.49	6.11
15.13	5.85
16.21	5.46
17.28	5.13
17.38	5.10

;

preferably, the X-ray powder diffraction pattern of the tosylate salt crystal form B, expressed in 2θ angles, comprises diffraction peaks as shown in the following table:

Diffraction angle [°2θ]	d-Spacing [Å]	Relative intensity [%]
5.09	17.34	12.68
5.64	15.66	41.63
7.06	12.51	5.42
7.84	11.26	20.64

9.22	9.59	12.32
10.11	8.74	20.58
10.87	8.13	15.17
11.36	7.78	29.85
12.03	7.35	19.43
13.44	6.58	52.29
13.60	6.51	39.59
14.49	6.11	50.60
15.13	5.85	47.76
16.21	5.46	9.92
17.28	5.13	100.00
17.38	5.10	92.84
18.58	4.77	21.10
19.55	4.54	16.10
20.45	4.34	43.73
21.15	4.20	40.38
22.15	4.01	51.56
22.89	3.88	17.76
23.97	3.71	38.67
25.03	3.56	16.06
27.08	3.29	15.22

29.19	3.06	7.76
30.07	2.97	3.42
30.73	2.91	2.25
31.60	2.83	3.03
35.97	2.49	2.34
37.84	2.38	2.90

;

more preferably, the X-ray powder diffraction pattern of the tosylate salt crystal form B, expressed in 2θ angles, is substantially as shown in FIG. 9.

8. The tosylate salt crystal form B according to claim 5, wherein one or more of the following conditions are met:

(1) the tosylate salt crystal form B has a differential scanning calorimetry thermogram comprising an endothermic peak at a peak temperature of 222.98°C±3°C, with a heat of fusion of 54.52 J/g;

preferably, the differential scanning calorimetry thermogram of the tosylate salt crystal form B is substantially as shown in FIG. 8;

(2) the tosylate salt crystal form B shows no significant weight loss before decomposition in the thermogravimetric analysis;

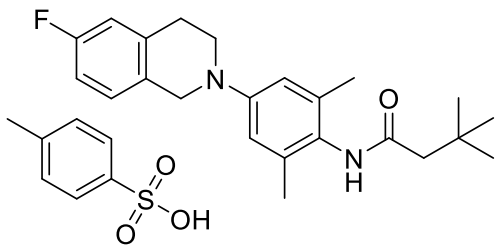
preferably, the tosylate salt crystal form B has a thermogravimetric analysis thermogram substantially as shown in FIG. 8;

and (3) the tosylate salt crystal form B is an anhydrous crystal form of a monotosylate salt.

9. A crystal form, wherein the crystal form is a tosylate salt crystal form E of a compound of formula I, or a tosylate salt crystal form A of a compound of formula I,

wherein the tosylate salt crystal form E has an X-ray powder diffraction pattern, obtained using Cu-Kα radiation and expressed in 2θ angles, comprising diffraction peaks at the following positions: 5.60°±0.2°, 8.15°±0.2°, and 17.33°±0.2°;

wherein the tosylate salt crystal form A has an X-ray powder diffraction pattern, obtained using Cu-Kα radiation and expressed in 2θ angles, comprising diffraction peaks at the following positions: 5.17°±0.2°, 10.40°±0.2°, and 18.34°±0.2°;



structural formula of tosylate salt of compound of formula I.

10. The crystal form according to claim 9, wherein one or more of the following conditions are met:

(1) the X-ray powder diffraction pattern of the tosylate salt crystal form E, expressed in 2θ angles, further comprises diffraction peaks at one or more of the following positions: 11.31°±0.2°, 13.89°±0.2°, and 19.88°±0.2°;

preferably, the X-ray powder diffraction pattern further comprises diffraction peaks at one or more of the following positions: 9.85°±0.2°, 10.02°±0.2°, 18.83°±0.2°, and 20.23°±0.2°;

more preferably, the X-ray powder diffraction pattern further comprises diffraction peaks at one or more of the following positions: 14.15°±0.2°, 16.12°±0.2°, 17.88°±0.2°, 22.33°±0.2°, 25.51°±0.2°, and 27.23°±0.2°;

further preferably, the X-ray powder diffraction pattern further comprises diffraction peaks at one or more of the following positions: 3.34°±0.2°, 16.43°±0.2°, 21.72°±0.2°, 22.87°±0.2°, 23.17°±0.2°, 23.99°±0.2°, 24.51°±0.2°, 30.48°±0.2°, 33.75°±0.2°, and 34.38°±0.2°;

and (2) the X-ray powder diffraction pattern of the tosylate salt crystal form A, expressed in 2θ angles, further comprises diffraction peaks at one or more of the following positions: 8.55°±0.2° and 14.19°±0.2°;

preferably, the X-ray powder diffraction pattern further comprises diffraction peaks at one or more of the following positions: 7.04°±0.2° and 17.56°±0.2°;

more preferably, the X-ray powder diffraction pattern further comprises diffraction peaks at one or more of the following positions: 11.16°±0.2°, 14.61°±0.2°, 15.14°±0.2°, 19.85°±0.2°, 21.01°±0.2°, 22.21°±0.2°, 22.58°±0.2°, and 24.65°±0.2°.

11. The crystal form according to claim 9, wherein one or more of the following conditions are met:

(1) the X-ray powder diffraction pattern of the tosylate salt crystal form E, expressed in 2θ angles, comprises diffraction peaks as shown in the following table:

Diffraction angle [°2θ]	d-Spacing [Å]
5.60	15.78
8.15	10.84
9.85	8.97
10.02	8.82
11.31	7.81
13.89	6.37
14.15	6.25
16.12	5.50
17.33	5.11
17.88	4.96
18.83	4.71
19.88	4.46
20.23	4.39
22.33	3.98
25.51	3.49
27.23	3.27

;

preferably, the X-ray powder diffraction pattern of the tosylate salt crystal form

E, expressed in 2θ angles, comprises diffraction peaks as shown in the following table:

Diffraction angle [°2θ]	d-Spacing [Å]	Relative intensity [%]
3.34	26.40	1.94
5.60	15.78	61.93
8.15	10.84	77.26
9.85	8.97	16.17
10.02	8.82	8.84
11.31	7.81	20.19
13.89	6.37	27.76
14.15	6.25	5.07
16.12	5.50	5.27
16.43	5.39	2.65
17.33	5.11	100.00
17.88	4.96	6.26
18.83	4.71	16.74
19.88	4.46	21.55
20.23	4.39	11.05
21.72	4.09	2.05
22.33	3.98	5.81
22.87	3.89	3.11

23.17	3.84	3.37
23.99	3.71	2.46
24.51	3.63	2.21
25.51	3.49	5.10
27.23	3.27	7.40
30.48	2.93	1.21
33.75	2.65	3.76
34.38	2.61	2.48

;

more preferably, the X-ray powder diffraction pattern of the tosylate salt crystal form E, expressed in 2θ angles, is substantially as shown in FIG. 10;

and (2) the X-ray powder diffraction pattern of the tosylate salt crystal form A, expressed in 2θ angles, comprises diffraction peaks as shown in the following table:

Diffraction angle [°2θ]	d-Spacing [Å]
5.17	17.09
7.04	12.55
8.55	10.33
10.40	8.50
11.16	7.92
14.19	6.24
14.61	6.06

15.14	5.85
17.56	5.05
18.34	4.83
19.85	4.47
21.01	4.23
22.21	4.00
22.58	3.93
24.65	3.61

;

preferably, the X-ray powder diffraction pattern of the tosylate salt crystal form A, expressed in 2θ angles, comprises diffraction peaks as shown in the following table:

Diffraction angle [°2θ]	d-Spacing [Å]	Relative intensity [%]
5.17	17.09	100.00
7.04	12.55	10.07
7.98	11.07	1.98
8.55	10.33	11.39
10.40	8.50	43.38
11.16	7.92	6.91
11.51	7.68	4.54
13.15	6.73	3.62

14.19	6.24	14.11
14.61	6.06	6.71
15.14	5.85	8.26
16.15	5.48	3.28
17.56	5.05	10.38
18.34	4.83	14.19
19.52	4.54	4.23
19.85	4.47	7.91
20.44	4.34	4.30
21.01	4.23	5.89
21.56	4.12	4.54
22.21	4.00	5.03
22.58	3.93	9.09
23.75	3.74	4.57
24.65	3.61	5.23
25.38	3.51	4.15
26.45	3.37	3.28
26.96	3.30	2.68
28.82	3.10	1.43
30.53	2.93	1.03
31.81	2.81	0.89

35.27	2.54	0.63
37.51	2.40	0.23

;

more preferably, the X-ray powder diffraction pattern of the tosylate salt crystal form A, expressed in 2θ angles, is substantially as shown in FIG. 6.

12. The crystal form according to any one of claims 9 to 11, wherein one or more of the following conditions are met:

(1) the tosylate salt crystal form E has a differential scanning calorimetry thermogram comprising two endothermic peaks at peak temperatures of 180.26°C±3°C and 224.05°C±3°C;

preferably, the differential scanning calorimetry thermogram of the tosylate salt crystal form E has an endothermic peak at a peak temperature of 180.26°C±3°C, with a heat of fusion of 26.13 J/g; and an endothermic peak at a peak temperature of 224.05°C±3°C, with a heat of fusion of 59.89 J/g;

further preferably, the differential scanning calorimetry thermogram of the tosylate salt crystal form E is substantially as shown in FIG. 11;

(2) the tosylate salt crystal form E has a thermogravimetric analysis thermogram substantially as shown in FIG. 11;

(3) the tosylate salt crystal form E is an anhydrous crystal form of a monotosylate salt;

(4) the tosylate salt crystal form A has a differential scanning calorimetry thermogram comprising an endothermic peak at a peak temperature of 223.99°C±3°C;

preferably, the differential scanning calorimetry thermogram of the tosylate salt crystal form A comprises an endothermic peak at a peak temperature of 223.99°C±3°C, with a heat of fusion of 68.20 J/g;

further preferably, the differential scanning calorimetry thermogram of the tosylate salt crystal form A is substantially as shown in FIG. 5;

(5) the tosylate salt crystal form A has a thermogravimetric analysis thermogram substantially as shown in FIG. 5;

and (6) the tosylate salt crystal form A is an anhydrous crystal form of a monotosylate salt.

13. A pharmaceutical composition comprising the mesylate salt crystal form A according to any one of claims 1 to 4, the tosylate salt crystal form B according to any one of claims 5 to 8, or the crystal form according to any one of claims 9 to 12, and a pharmaceutical excipient.

14. Use of the mesylate salt crystal form A according to any one of claims 1 to 4, the tosylate salt crystal form B according to any one of claims 5 to 8, the crystal form according to any one of claims 9 to 12, or the pharmaceutical composition according to claim 13 in the manufacture of a medicament,

the medicament is for use in treating and/or preventing a disease or condition affected by voltage-gated potassium channels.

15. Use of the mesylate salt crystal form A according to any one of claims 1 to 4, the tosylate salt crystal form B according to any one of claims 5 to 8, the crystal form according to any one of claims 9 to 12, or the pharmaceutical composition according to claim 13 in the manufacture of a medicament,

the medicament is for use in treating and/or preventing one or more of the following diseases or conditions: epilepsy, amyotrophic lateral sclerosis, depression, and pain.