WHAT IS CLAIMED IS:

1. A preparation method of a solid-state electrolyte membrane, comprising the following steps:

Step 1: dispersing a polymer uniformly in an organic solvent to obtain solution A;

Step 2: adding a thiol-containing micromolecule to the solution A to obtain solution B;

Step 3: adding a solid-state electrolyte to the solution B, followed by dispersing uniformly, to obtain solution C; and

Step 4: subjecting the solution C to electrolyte membrane preparation, followed by heat treatment and pressing, to prepare the solid-state electrolyte membrane;

the polymer comprises one or more of chitosan, chitin, a chitosan-polylactic acid copolymer, and chitosan-polyethylene glycol-dopamine; and a mass percentage of the polymer in the solid-state electrolyte membrane is 1%-5%;

wherein in Step 2, a mass percentage of the thiol-containing micromolecule in the solid-state electrolyte membrane is 0.1%-1%; and the thiol-containing micromolecule comprises one or more of 1,6-hexanedithiol, 1,2-ethanedithiol, 1,4-butanedithiol, 1,5-pentanedithiol, and 1,3-propanedithiol;

wherein in Step 3, the solid-state electrolyte comprises one or more of $Li_{10}GeP_2S_{12}$, $Li_7P_3S_{11}$, $Li_{10}SnP_2S_{12}$, Li_6PS_5Cl, Li_6PS_5I, and $Li_{5.5}PS_{4.5}Cl_{1.5}$.

2. The preparation method according to claim 1, wherein in Step 1, the organic solvent comprises one or more of benzene, toluene, ethylbenzene, xylene, acetonitrile, N,N-dimethylformamide, N-methylpyrrolidone, isopropanol, and acetone.

3. The preparation method according to claim 1, wherein in Step 4, a membrane preparation method for the electrolyte membrane preparation comprises one of tape casting, vacuum filtration, and wet coating.

4. The preparation method according to claim 1, wherein in Step 4, a temperature for the heat treatment is 100°C-200°C and a duration for the heat treatment is 5 h-12 h.

5. The preparation method according to claim 1, wherein in Step 4, a pressure for the pressing is 5 MPa-600 MPa.

6. A solid-state electrolyte membrane prepared by the preparation method according to claim 1.

7. Use of the solid-state electrolyte membrane according to claim 6 in a lithium battery.