

## WHAT IS CLAIMED IS:

1. A self-healing silicone rubber, characterised in that it comprises the following raw materials in parts by weight: 80-100 parts of hydroxyl-terminated polydimethylsiloxane, 25-50 parts of hydroxyl-terminated polydimethylsiloxane containing furan groups on the side chains, 22.75-47.75 parts of polydimethylsiloxane containing maleimide groups at both ends, 5-15 parts of a dynamic cross-linking agent, and 0.02-0.20 parts of a catalyst; wherein the molar ratio of the furan groups in the hydroxyl-terminated polydimethylsiloxane containing furan groups on the side chains to the maleimide groups in the polydimethylsiloxane containing maleimide groups at both ends is 1.00:(1.00-1.05).

2. The self-healing silicone rubber according to claim 1, characterised in that: the dynamic cross-linking agent is at least one selected from difurfuryl disulfide, bis[3-(triethoxysilyl) propyl] diselenide, bis[3-(trimethoxysilyl) propyl] diselenide, and bis[3-(triethoxysilyl) propyl] disulfide.

3. The self-healing silicone rubber according to claim 2, characterised in that: when the molar ratio of the furan groups in the hydroxyl-terminated polydimethylsiloxane containing furan groups on the side chains to the maleimide groups in the polydimethylsiloxane containing maleimide groups at both ends is 1:1, then the dynamic cross-linking agent is at least one selected from bis[3-(triethoxysilyl) propyl] diselenide, bis[3-(trimethoxysilyl) propyl] diselenide, and bis[3-(triethoxysilyl) propyl] disulfide.

4. The self-healing silicone rubber according to claim 2, characterised in that: when the molar ratio of the furan groups in the hydroxyl-terminated polydimethylsiloxane containing furan groups on the side chains to the maleimide groups in the polydimethylsiloxane containing maleimide groups at both ends is  $>1$  and  $\leq 1.05$ , then the dynamic cross-linking agent consists of difurfuryl disulfide in combination with at least one selected from bis[3-(triethoxysilyl) propyl] diselenide, bis[3-(trimethoxysilyl) propyl] diselenide, and bis[3-(triethoxysilyl) propyl] disulfide; the difference between the molar amount of the furan groups in the

hydroxyl-terminated polydimethylsiloxane containing furan groups on the side chains and the molar amount of the maleimide groups in the polydimethylsiloxane containing maleimide groups at both ends is equal to 1.00-1.02 times the molar amount of the furan groups in the difurfuryl disulfide.

5. The self-healing silicone rubber according to claim 1, characterised in that: the hydroxyl-terminated polydimethylsiloxane containing furan groups on the side chains is prepared from hydroxyl-terminated methyl vinyl silicone oil, 3-mercapto-1-propylamine, furfuryl chloride, and a photoinitiator; the molar ratio of vinyl groups in the hydroxyl-terminated methyl vinyl silicone oil to mercapto groups in the 3-mercapto-1-propylamine is 1:1; the molar ratio of amino groups in the 3-mercapto-1-propylamine to acyl chloride groups in the furfuryl chloride is 1:1.

6. The self-healing silicone rubber according to claim 5, characterised in that: the preparation method for the hydroxyl-terminated polydimethylsiloxane containing furan groups on the side chains comprises the following steps:

step 1: dissolve hydroxyl-terminated methyl vinyl silicone oil and a photoinitiator in a mixed solvent formed from methyl ethyl ketone and acetone; wherein the photoinitiator is at least one selected from photoinitiator TPO, photoinitiator 784, photoinitiator 819, photoinitiator 295, photoinitiator 184, and photoinitiator 1173; the mass ratio of the photoinitiator to the hydroxyl-terminated methyl vinyl silicone oil is 1:(50-100); mix uniformly to obtain mixed solution A;

simultaneously prepare mixed solution B: dissolve 3-mercapto-1-propylamine in a mixed solvent formed from methyl ethyl ketone and acetone and mix uniformly to obtain mixed solution B; the content of 3-mercapto-1-propylamine in the obtained mixed solution B is 0.5-5%;

step 2: place mixed solution A under a 200-365nm ultraviolet lamp with an illumination intensity of 100-500 $\mu$ W/cm<sup>2</sup>; while maintaining stirring at 100-300rpm, slowly add mixed solution B to mixed solution A at a rate of 0.1-2g/min; after the addition of mixed solution B is complete, continue the reaction for 15-30 minutes to obtain mixed solution C;

step 3: add an acid-binding agent to mixed solution C; the acid-binding agent

is at least one selected from triethylamine, pyridine, and N, N-diisopropylethylamine; the molar ratio of the acid-binding agent to the 3-mercapto-1-propylamine is (2-3):1; place at room temperature, add furfuryl chloride, maintain stirring at 100-300 rpm and react for 12-24h; after the reaction ends, filter the reaction mixture to remove solid filter residue, then remove methyl ethyl ketone and acetone under reduced pressure to obtain the hydroxyl-terminated polydimethylsiloxane containing furan groups on the side chains.

7. The self-healing silicone rubber according to claim 1, characterized in that: the polydimethylsiloxane containing maleimide groups at both ends is prepared from hydroxyl silicone oil with a molecular weight of 1000-4000 and 4-(maleimido) phenyl isocyanate; the molar ratio of the -NCO group in the 4-(maleimido) phenyl isocyanate to the -OH groups in the hydroxyl silicone oil with a molecular weight of 1000-4000 is 1.00:(0.80-1.02).

8. The self-healing silicone rubber according to claim 7, characterized in that: the preparation method for the polydimethylsiloxane containing maleimide groups at both ends comprises the following steps:

step 1: uniformly mix 0.1-0.25 parts of a polymerization inhibitor, 10 parts of hydroxyl silicone oil with a molecular weight of 1000-4000, and 25-50 parts of acetone to obtain mixed solution a; wherein the polymerization inhibitor is at least one selected from MEHQ, 701, and 702;

simultaneously, uniformly mix 4-(maleimido) phenyl isocyanate, an organotin catalyst, and acetone to obtain mixed solution b; the content of 4-(maleimido) phenyl isocyanate in mixed solution b is 1-10%; the mass ratio of the organotin catalyst to the 4-(maleimido) phenyl isocyanate is 1:(1000-5000);

step 2: under nitrogen protection, adjust the temperature of the mixed solution a to 70-78°C and adjust the stirring speed of the mixed solution a to 200-400rpm; slowly add mixed solution b to mixed solution a at a rate of 0.1-2g/min; after the addition of mixed solution b is complete, continue the reaction for 30-60 minutes until the -NCO content in the reaction mixture reaches 0; remove acetone under reduced pressure to obtain the polydimethylsiloxane containing maleimide groups at

both ends.

9. The self-healing silicone rubber according to claim 7, characterized in that: the catalyst is at least one selected from dibutyltin dilaurate, dioctyltin dilaurate, stannous octoate, di(dodecyl) dibutyltin, dibutyltin diacetate, dioctyltin dinedecanoate, and GJ-100 catalyst.

10. An injection bottle sealing pad prepared from the self-healing silicone rubber according to any one of claims 1 to 9, characterized in that: it comprises the following steps:

step 1: separately prepare hydroxyl-terminated polydimethylsiloxane containing furan groups on the side chains, and polydimethylsiloxane containing maleimide groups at both ends;

step 2: under nitrogen protection, place accurately measured hydroxyl-terminated polydimethylsiloxane, hydroxyl-terminated polydimethylsiloxane containing furan groups on the side chains, polydimethylsiloxane containing maleimide groups at both ends, dynamic cross-linking agent, and catalyst into a kneader, and knead for 5-10 minutes to obtain a self-healing silicone rubber mixture;

step 3: mix 10 parts of the self-healing silicone rubber mixture with 20-40 parts of tetrahydrofuran uniformly to obtain a casting solution, cast the casting solution into a polytetrafluoroethylene mold, subject the polytetrafluoroethylene mold to reduced pressure distillation at 60-75°C to remove the tetrahydrofuran solvent, then transfer to 80-105°C/atmospheric pressure to cure for 2-6 hours, and demold to obtain the injection bottle sealing pad.