sulfolane, acetone, hexamethylphosphoramide, acetonitrile, and 1,3-dimethyl-2-imidazolinone, the oxidizing agent is a peroxide, the halogen compound is a fluoride, and the quaternary ammonium hydroxide is at least one selected from the group consisting of tetramethylammonium hydroxide, tetrapropylammonium hydroxide, tetrabutylammonium hydroxide, tetraethylammonium hydroxide, benzyltrimethylammonium hydroxide, choline, (2-hydroxyethyl)trimethylammonium hydroxide, and tris(2-hydroxyethyl)methylammonium hydroxide.

[0007] In some embodiments, the azole corrosion inhibitor bears an electron-donating group, and the electron-donating group is at least one selected from the group consisting of methyl, amino, hydroxyl, mercapto, phenyl, and alkyl.

[0008] In some embodiments, a content of the cyclic organic amine in the photoresist stripper is in a range of 5 wt% to 30 wt%;

and/or a content of the alcohol ether organic solvent in the photoresist stripper is in a range of 25 wt% to 60 wt%;

and/or a content of the diol in the photoresist stripper is in a range of 30 wt% to 40 wt%;

and/or a content of the azole corrosion inhibitor in the photoresist stripper is less than 0.5 wt%.

[0009] In some embodiments, a content of the cyclic organic amine in the photoresist stripper is in a range of 10 wt% to 30 wt%;

and/or a content of the alcohol ether organic solvent in the photoresist stripper is in a range of 30 wt% to 56 wt%;

and/or a content of the diol in the photoresist stripper is in a range of 31 wt% to 40 wt%;

and/or a content of the azole corrosion inhibitor in the photoresist stripper is in a range of 0.01 wt% to 0.3 wt%.

[0010] In some embodiments, the photoresist stripper includes: 53.3 wt% of diethylene glycol monobutyl ether, 31.5 wt% of ethylene glycol, 15 wt% of N-aminoethylpiperazine, and 0.2 wt% of tolyltriazole;

or the photoresist stripper includes: 53.3 wt% of diethylene glycol monomethyl ether, 31.5 wt% of ethylene glycol, 15 wt% of 1-(2-hydroxyethyl)piperazine, and 0.2 wt% of tolyltriazole;

or the photoresist stripper includes: 50.78 wt% of dipropylene glycol monomethyl ether, 32 wt% of diethylene glycol, 17 wt% of N-aminoethylpiperazine, and 0.22 wt% of 1-phenyltetrazole-5-thiol;

or the photoresist stripper includes: 50.78 wt% of dipropylene glycol monomethyl ether, 32 wt% of diethylene glycol, 17 wt% of 1-(2-hydroxyethyl)methylpiperazine, and 0.22 wt% of 5-

capable of protecting GaAs and PI substrates and use thereof. The photoresist stripper includes a cyclic organic amine, an alcohol ether organic solvent, a diol, and an azole corrosion inhibitor, where the cyclic organic amine has a chemical formula as shown in formula (I), where in the formula (I), R1 and R2 are each independently -H, -CH_3, -NH_2, -C_6H_5, -$CH_3C_6H_5$, -CH_3CH_2OH or -$CH_3CH_2NH_2$, and R3 is -H or -CH_3; the diol is an aliphatic diol containing 2 to 6 carbon atoms; and the photoresist stripper is free of any one selected from the group consisting of water, an aprotic polar solvent, an oxidizing agent, a halogen compound, a hydroxylamine, a quaternary ammonium hydroxide, and an inorganic base. In the present disclosure, the photoresist stripper has excellent stripping capabilities, is free of water and an aprotic polar solvent, and includes not only a cyclic amine, but also corrosion inhibitors compounded from a diol and an azole. By adjusting the contents of the two corrosion inhibitors, the photoresist stripper can protect PI and prevent corrosion against GaAs and metal substrates such as Cu, Al, and Ti. More specifically: (1) the photoresist stripper is an organic system, free of water and an aprotic polar solvent, such as N-methyl-2-pyrrolidone, dimethyl sulfoxide, N,N-dimethylacetamide, N,N-dimethylformamide, sulfolane, acetone, hexamethylphosphoramide, acetonitrile, and DMI, thus avoiding damage to the substrate material by an aprotic polar solvent. (2) In the present disclosure, a cyclic amine is introduced. The cyclic amine, on the one hand, provides better protection to the substrate than other organic amines, and, on the other hand, is capable of cleaving long-chain photoresists, and the broken long-chain photoresists can be further dissolved by the diol and alcohol ethers. The synergistic effect of the cyclic amine, the alcohol ether, and the diol ensures complete removal of the photoresist. (3) In addition to using a cyclic amine, corrosion inhibitors compounded from a diol and an azole are selected. By adjusting the contents of the diol and the azole, specifically by substantially increasing the content of the diol and reducing the amount of the azole corrosion inhibitor, the photoresist stripper can not only protect PI, but also prevent corrosion against GaAs and metal substrates. On the one hand, the diol in a content of 30 wt% to 40 wt% can act both as a corrosion inhibitor and as a solvent, which, in turn, can enhance the substrate protection and the stripping capabilities, and can allow the photoresist stripper with a moderate viscosity to facilitate subsequent cleaning. On the other hand, the amount of azoles in the compounded corrosion inhibitor is reduced, thus preventing the cleaning residues caused by the excessive adsorption of azole corrosion inhibitors on the wafer surface. The synergistic effect of the cyclic amine, the diol, and the azole corrosion inhibitor not only improves the photoresist removal effect, but also prevents the corrosion against PI, GaAs, and metal

N,N-dimethylformamide, sulfolane, acetone, hexamethylphosphoramide, acetonitrile, and 1,3-dimethyl-2-imidazolinone (DMI); the oxidizing agent includes, but is not limited to, a peroxide, for example, hydrogen peroxide; the halogen compound includes, but is not limited to, a fluoride, for example, hydrogen fluoride; and the quaternary ammonium hydroxide includes, but is not limited to, at least one selected from the group consisting of tetramethylammonium hydroxide, tetrapropylammonium hydroxide, tetrabutylammonium hydroxide, tetraethylammonium hydroxide, benzyltrimethylammonium hydroxide, choline, (2-hydroxyethyl)trimethylammonium hydroxide, and tris(2-hydroxyethyl)methylammonium hydroxide.

[0053] In some embodiments of the present disclosure, the photoresist stripper further includes a surfactant and/or a pH adjuster. In some embodiments, the surfactant is at least one selected from the group consisting of a nonionic surfactant, an anionic surfactant, and a cationic surfactant. In some embodiments, the nonionic surfactant is a polyoxyethylene, the anionic surfactant is an alkylbenzene sulfonate and/or an alkyl sulfonate, and the cationic surfactant is an alkyl imidazoline salt and/or a fatty amine salt. In some embodiments, the pH adjuster is at least one selected from the group consisting of citric acid, malic acid, maleic acid, N,N-dimethylethanolamine (DMEA), diethylamine, an acidic amino acid, and an alkaline amino acid.

[0054] In a specific embodiment of the present disclosure, the photoresist stripper includes: 53.3 wt% of diethylene glycol monobutyl ether, 31.5 wt% of ethylene glycol, 15 wt% of N-aminoethylpiperazine, and 0.2 wt% of tolyltriazole;

[0055] or the photoresist stripper includes: 53.3 wt% of diethylene glycol monomethyl ether, 31.5 wt% of ethylene glycol, 15 wt% of 1-(2-hydroxyethyl)piperazine, and 0.2 wt% of tolyltriazole;

[0056] or the photoresist stripper includes: 50.78 wt% of dipropylene glycol monomethyl ether, 32 wt% of diethylene glycol, 17 wt% of N-aminoethylpiperazine, and 0.22 wt% of 1-phenyltetrazole-5-thiol;

[0057] or the photoresist stripper includes: 50.78 wt% of dipropylene glycol monomethyl ether, 32 wt% of diethylene glycol, 17 wt% of 1-(2-hydroxyethyl)methylpiperazine, and 0.22 wt% of 5-aminotetrazole;

[0058] or the photoresist stripper includes: 57.7 wt% of diethylene glycol monobutyl ether, 34 wt% of ethylene glycol, 8 wt% of 1-(2-hydroxyethyl)methylpiperazine, and 0.3 wt% of tolyltriazole;

corrosion inhibitors compounded from a diol and an azole. By adjusting the contents of the two corrosion inhibitors, the photoresist stripper can protect PI and prevent corrosion against GaAs and metal substrates such as Cu, Al, and Ti. More specifically, some embodiments of the present disclosure have the following key points and advantages:

[0073] (1) In the present disclosure, the photoresist stripper is an organic system, free of water and an aprotic polar solvent, such as N-methyl-2-pyrrolidone, dimethyl sulfoxide, N,N-dimethylacetamide, N,N-dimethylformamide, sulfolane, acetone, hexamethylphosphoramide, acetonitrile, and DMI, thus avoiding damage to the substrate material by an aprotic polar solvent.

[0074] (2) In the present disclosure, a cyclic amine is introduced. The cyclic amine, on the one hand, provides better protection to the substrate than other organic amines, and, on the other hand, is capable of cleaving long-chain photoresists, and the broken long-chain photoresists can be further dissolved by the diol and alcohol ethers. The synergistic effect of the cyclic amine, the alcohol ether and the diol ensures complete removal of the photoresist.

[0075] (3) In addition to using a cyclic amine, corrosion inhibitors compounded from a diol and an azole are selected. By adjusting the contents of the diol and the azole, specifically by substantially increasing the content of the diol and reducing the amount of the azole corrosion inhibitor, the photoresist stripper can not only protect PI, but also can prevent corrosion against GaAs and metal substrates. On the one hand, the diol in a content of 30 wt% to 40 wt% can act both as a corrosion inhibitor and as a solvent, which, in turn, can enhance the substrate protection and the stripping capabilities, and can allow the photoresist stripper with a moderate viscosity to facilitate subsequent cleaning. On the other hand, the amount of azoles in the compounded corrosion inhibitor is reduced, thus preventing the cleaning residues caused by the excessive adsorption of azole corrosion inhibitors on the wafer surface. The synergistic effect of the cyclic amine, the diol, and the azole corrosion inhibitor not only improves the photoresist removal effect, but also prevents the corrosion against PI, GaAs, and metal substrates such as Cu, Al, and Ti.

[0076] (4) In the photoresist stripper, the combined action of the cyclic amine, the alcohol ether, the diol and the azole effectively removes photoresists from a semiconductor wafer without corrosion against PI, GaAs, and metal substrates such as Cu, Al, and Ti, maintains the inherent yield of the wafer, and allows the subsequent process steps to proceed normally.

[0077] For greater clarity, the following detailed description is made by way of the following examples and comparative examples.