Claims:

1. A method for preparing hexafluoro-1,3-butadiene, comprising the following steps:

step (1), placing a trifluoroethenyl zinc bromide solution, a catalyst, and a first organic solvent into a pressure resistant reactor, adding bromotrifluoroethylene after displacement with an inert gas, and obtaining hexafluoro-1,3-butadiene through reaction, wherein

the catalyst comprises a monovalent copper salt or a monovalent copper oxide and an organophosphine ligand;

the organophosphine ligand is selected from any one or more of 1,10-phenanthroline, PPh_3, $PR_1R_2R_3$, $PPhR_1R_2$, PPh_2R_1, 1,2-bis(diphenylphosphino)ethane, and 2,2'-bis(diphenylphosphino)biphenyl, wherein R_1, R_2, and R_3 are each independently selected from any one of n-propyl, isopropyl, n-butyl, isobutyl, and tert-butyl;

the first organic solvent uses a polar aprotic organic solvent;

step (2), after the reaction is completed, allowing a gas-phase material to pass through a circulating spray system filled with a second organic solvent to absorb excess bromotrifluoroethylene and fluoro-olefin impurities generated during reaction, and purifying the unabsorbed crude hexafluoro-1,3-butadiene through distillation, wherein

the second organic solvent is selected from the polar aprotic organic solvent or ionic liquid.

2. The method for preparing hexafluoro-1,3-butadiene according to claim 1, wherein the monovalent copper salt is selected from any one or more of cuprous iodide, cuprous bromide, cuprous chloride, and cuprous acetate, and/or the monovalent copper oxide is cuprous oxide.

3. The method for preparing hexafluoro-1,3-butadiene according to claim 1 or 2, wherein the first organic solvent is selected from any one or more of N,N-dimethylformamide, N,N-dimethylacetamide, hexamethylphosphoramide, dimethyl

sulfoxide, sulfolane, and N-methyl-2-pyrrolidone, and a moisture content of the polar aprotic organic solvent used in the first organic solvent is ≤ 500 ppm;

the polar aprotic organic solvent used in the second organic solvent is selected from any one or more of the N,N-dimethylformamide, the N,N-dimethylacetamide, the hexamethylphosphoramide, the dimethyl sulfoxide, and the sulfolane; the ionic liquid is selected from any one or more of 1-butyl-3-methylimidazole phosphate, 1-butyl-3-methylimidazolium methanesulfonate, 1-butyl-3-methylimidazolium acetate, 1-butyl-3-methylimidazolium trifluoroacetate, 1-butyl-3-methylimidazolium nitrate, 1-butyl-3-methylimidazolium (L)-lactate, and 1-butyl-3-methylimidazolium hexafluorophosphate.

4. The method for preparing hexafluoro-1,3-butadiene according to any one of claims 1 to 3, wherein the first organic solvent in step (1) is selected from one of the N,N-dimethylformamide, the N,N-dimethylacetamide, and the sulfolane.

5. The method for preparing hexafluoro-1,3-butadiene according to any one of claims 1 to 4, wherein a mole ratio of trifluoroethenyl zinc bromide in the trifluoroethenyl zinc bromide solution to the monovalent copper salt or monovalent copper oxide is 1:(0.01-0.3); and a mole ratio of the monovalent copper salt or monovalent copper oxide to the organophosphine ligand is 1:(1.0-10).

6. The method for preparing hexafluoro-1,3-butadiene according to claim 5, wherein the mole ratio of the trifluoroethenyl zinc bromide in the trifluoroethenyl zinc bromide solution to the monovalent copper salt or monovalent copper oxide is 1:(0.01-0.20), preferably 1:(0.05-0.10); and the mole ratio of the monovalent copper salt or monovalent copper oxide to the organophosphine ligand is 1:(1.0-5.0), preferably 1:(1.0-3.0).

7. The method for preparing hexafluoro-1,3-butadiene according to any one of claims 1 to 6, wherein a mole ratio of the trifluoroethenyl zinc bromide in the trifluoroethenyl zinc bromide solution to the bromotrifluoroethylene is 1:(1-10), preferably 1:(1.0-5.0).

8. The method for preparing hexafluoro-1,3-butadiene according to any one of claims 1 to 7, wherein a reaction temperature in step (1) is 60-140 ^{o}C, a reaction pressure is 0.05-2.0 MPa, and a reaction time is 3-24 h; and preferably, the reaction temperature in step (1) is 80-120 ^{o}C, the reaction pressure is 0.3-1.0 MPa, and the

reaction time is 6-12 h.

9. The method for preparing hexafluoro-1,3-butadiene according to any one of claims 1 to 8, wherein the second organic solvent in step (2) is selected from any one or more of the N,N-dimethylformamide, the N,N-dimethylacetamide, the sulfolane, the 1-butyl-3-methylimidazole phosphate, the 1-butyl-3-methylimidazolium acetate, the 1-butyl-3-methylimidazolium trifluoroacetate, and the 1-butyl-3-methylimidazolium hexafluorophosphate.

10. The method for preparing hexafluoro-1,3-butadiene according to any one of claims 1 to 9, wherein the circulating spray system in step (2) is a two-stage circulating spray absorption system, and a temperature in the circulating spray system is -10 to 20 ^{o}C, and a pressure is 0-0.5 MPa; and preferably, the temperature in the circulating spray system is -5 to 10 ^{o}C, and the pressure is 0-0.2 MPa.

11. The method for preparing hexafluoro-1,3-butadiene according to any one of claims 1 to 10, wherein an absorbed organic solution in the circulating spray system in step (2) is treated through distillation, and the bromotrifluoroethylene is recycled and directly circulated for use.

12. The method for preparing hexafluoro-1,3-butadiene according to any one of claims 1 to 11, wherein a content of the bromotrifluoroethylene in the crude hexafluoro-1,3-butadiene treated by the circulating spray system is ≤ 0.3%, a content of heptafluorobutene is ≤ 0.02%, and a hexafluoro-1,3-butadiene product with purity ≥99.99% is obtained after distillation.