CLAIMS

1. A preparation method of an ionic liquid catalyst for producing renewable fuels from waste oils, comprising the following steps:

(1) preparation of a functional halogenated alkane monomer: reacting a carboxyl-containing halogenated alkane with a hydroxyl-containing functional monomer, followed by treatment to obtain the functional halogenated alkane monomer, wherein the hydroxyl-containing functional monomer is selected from at least one of N-cyclohexylhydroxylamine, N-(benzyloxycarbonyl)hydroxylamine, N-hydroxymethylnicotinamide, 5-hydroxytryptamine, and N-benzylethanolamine;

(2) preparation of an intermediate B: reacting a tertiary amine-containing monomer with the functional halogenated alkane monomer and treating to obtain an intermediate A, which is then treated with a strongly basic anion exchange resin to obtain the intermediate B; and

(3) preparation of the ionic liquid catalyst: mixing the intermediate B with polyoxometalate and reacting under heating, followed by drying to obtain the ionic liquid catalyst, wherein the polyoxometalate is a tri-metalate containing at least molybdenum and nickel metals.

2. The preparation method of the ionic liquid catalyst for producing renewable fuels from waste oils of claim 1, wherein the carboxyl-containing halogenated alkane has 6 to 11 carbon atoms.

3. The preparation method of the ionic liquid catalyst for producing renewable fuels from waste oils of claim 2, wherein

the carboxyl-containing halogenated alkane is selected from at least one of 6-chlorohexanoic acid, 7-chloroheptanoic acid, 8-chlorooctanoic acid, 9-chlorononanoic acid, 10-chlorodecanoic acid, 11-chloroundecanoic acid, 6-bromohexanoic acid, 7-bromoheptanoic acid, 8-bromooctanoic acid, 9-bromononanoic acid, 10-bromodecanoic acid, and 11-bromoundecanoic acid.

4. The preparation method of the ionic liquid catalyst for producing renewable fuels from waste oils of claim 1, wherein the hydroxyl-containing functional monomer

is selected from N-(benzyloxycarbonyl)hydroxylamine.

5. The preparation method of the ionic liquid catalyst for producing renewable fuels from waste oils of claim 1, wherein the tertiary amine-containing monomer is selected from at least one of trihexylamine, triheptylamine, trioctylamine, pyridine, N,N,N',N'-tetramethylethylenediamine, N,N,N',N'-tetramethyl-1,4-butanediamine, and N,N,N',N'-tetramethylhexamethylenediamine .

6. The preparation method of the ionic liquid catalyst for producing renewable fuels from waste oils of claim 1, wherein the tri-metal polyoxometalate is selected from at least one of molybdenum-nickel-cobaltate, molybdenum-nickel-manganate, and molybdenum-nickel-zincate.

7.The preparation method of the ionic liquid catalyst for producing renewable fuels from waste oils of claim 1, wherein the preparation method of the tri-metal polyoxometalate is as follows:

adding hydrogen peroxide, nickel sulfate, and a third metal sulfate to deionized water, and then adding the mixture dropwise to a boiling ammonium molybdate solution, wherein the boiling state of the ammonium molybdate solution is maintained during the dropwise addition, followed by further boiling for 1 to 2 hours to obtain the tri-metal polyoxometalate, wherein the third metal sulfate is selected from one of cobalt sulfate, manganese sulfate, or zinc sulfate.

~~6.~~ 8. An ionic liquid catalyst obtained by the preparation method of the ionic liquid catalyst for producing renewable fuels from waste oils of any one of claims 1 to 7.

9. A method for producing renewable fuels by treating waste oils with an ionic liquid catalyst, comprising the following steps:

S1: mixing circulating oil, waste oils, and the ionic liquid catalyst at a weight ratio of circulating oil: waste oils: ionic liquid catalyst of (1 to 6): 1: (0.002 to 0.005) to form a premix, raising the temperature of the premix to 280 to 380°C, followed by feeding the premix into a first reactor (4) for hydrogenation catalysis, wherein the ionic liquid catalyst is the ionic liquid catalyst obtained by the preparation method of claim 1;

S2: feeding a gaseous effluent from the first reactor (4) into a second reactor (5)

for further hydrogenation catalysis to obtain reactants and circulating oil, and feeding bottom effluent from the first reactor (4) into an ash-discharging hot high-pressure separator (14) to discharge wastes containing high-ash oil and tailings;

S3: discharging the reactants into a hot high-pressure separator (7) to be separated into a gas phase A and a liquid phase A, wherein the gas phase A is fed into a cold high-pressure separator (16) and is separated into circulating hydrogen, distillate oil, and residual oil; a part of the liquid phase A is used as circulating oil, and the other part is fed into a hot low-pressure separator (8) and is separated into wastes containing high-ash oil and tailings as well as a liquid phase B; and

S4: feeding the liquid phase B into a fractionation tower (10) for fractionation to obtain renewable fuels.

10. The method for producing renewable fuels by treating waste oils with the ionic liquid catalyst of claim 9, wherein the temperature of the premix after heating is 300 to 360°C;

the waste oils comprise at least one of acidified oil, waste cooking oil, swill oil, and animal fat;

the acid value of the waste oils is greater than 40 mgKOH/g; and

the renewable fuels include biodiesel and/or bio-jet fuel.

11. The method for producing renewable fuels by treating waste oils with the ionic liquid catalyst of claim 10, wherein the renewable fuels comprise hydrocarbon-based biodiesel, naphtha, and kerosene.

12. The method for producing renewable fuels by treating waste oils with the ionic liquid catalyst of claim 9, wherein the circulating oil has a density of 0.76 to 0.82 g/mL and is a biomass hydrocarbon compound with a derived cetane number (DCN) exceeding 80.

13. The application of the method for producing renewable fuels by treating waste oils with the ionic liquid catalyst of any one of claims 9 to 12 in the preparation of bioenergy.

14. The application of claim 13, wherein the bioenergy is biodiesel or bio-jet fuel.