TITLE

AZEOTROPE-LIKE COMPOSITION COMPRISING Z-1,1,1,4,4,4-HEXAFLUORO-2-BUTENE

BACKGROUND INFORMATION

Field of the Disclosure

The present invention relates to an azeotrope-like composition made up of Z-1,1,1,4,4,4-hexafluoro-2-butene and isopropanol.

Description of the Related Art

To date, halogenated hydrocarbons such as chlorofluorocarbons (CFC), hydrochlorofluorocarbons (HCFC) and hydrofluorocarbons (HFC) have been used within many industries in a wide range of applications, including aerosol propellants, refrigerants, solvents, cleaning agents, thermoplastic and thermosetting foams for foaming agents (foam expansion agents), heat transfer mediums, gaseous dielectrics, fire extinguishing agents and fire suppression agents, power cycle working fluids, polymerization mediums, particulate removal fluids, carrier fluids, buffing abrasive agents, and displacement drying agents.

At the same time, CFCs and HCFCs are known to be ozone damaging substances, while HFCs, although not damaging to the ozone layer, are greenhouse gases which impact global warming. As such, alternative compositions that have a lower environmental impact, in other words, an ozone depletion potential of zero along with extremely low potential in regard to global warming, are now being sought.

Azeotropes, which do not fractionate during vaporization while being used or collected, in other words, have fixed boiling point characteristics, and do not fractionate when boiled or vaporized, are known to be effective as this kind of alternative composition (see, for example, Patent Documents 1, 2 and 3). As noted in Patent Document 1, however, it is not theoretically possible to predict whether or not an azeotrope will be formed, and as such, work is still under consideration regarding combining various substances together in order to seek new azeotropes with excellent characteristics.

SUMMARY

The present invention aims to solve the abovementioned problems by providing a new azeotrope-like composition that can be used for a wide range of industrial purposes.

The inventors of the present invention have discovered that Z-1,1,1,4,4,4-hexafluoro-2-butene (Z-HFO-1336mzzm), which has an ozone depletion potential of 0, along with a global warming potential of under 10, forms isopropanol (IPA) and an azeotrope, wherein the volume resistivity is furthermore significantly reduced by a small quantity of IPA, thereby arriving at the present invention.

In other words, the present invention has the following characteristics.

1. An azeotrope-like composition including 93.0 – 99.9 mass% Z-1,1,1,4,4,4-hexafluoro-2-butene and 0.1 - 7 mass% isopropanol.
2. A solid-surface cleaning agent including the azeotrope-like composition in 1.
3. The cleaning agent in 2, wherein the solid-surface is a semiconductor surface.
4. A coolant including the azeotrope-like composition in 1.
5. A foaming agent including the azeotrope-like composition in 1.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments are illustrated in the accompanying figures to improve understanding of concepts as presented herein.

FIG. 1: depicts the boiling curve of the mixture of Z-HFO-1336mzzm and IPA.

FIG. 2: depicts the volume resistivity of the mixture of Z-HFO-1336mzzm and IPA.

DETAILED DESCRIPTION

The present invention allows the provision of an azeotrope-like composition with an ozone depletion potential of 0, along with an extremely low global warming potential.

The composition in the present invention has low volume resistivity, allowing the adherence or re-adherence of microscopic particles as a result of static electricity to be controlled, ensuring low viscosity and surface tension, as well as high density, with the result that it has high osmotic force and is particularly suited to use as a cleaning agent, particularly a cleaning agent (surface processing agent) for solid surfaces, for example, in the removal of microscopic particles from semiconductor surfaces.

Furthermore, Z-HFO-1336mzzm becomes an azeotrope with the addition of a microscopic quantity of IPA, which is cheap and harmless, and which further significantly reduces volume resistivity, with the result that the azeotrope does not become flammable, and additionally, since only a microscopic quantity of IPA is required, it is possible to limit contamination by moisture in the atmosphere, which is extremely compatible with IPA.

The present invention is an azeotrope-like composition, substantively formed from Z-1,1,1,4,4,4-hexafluoro-2-butene (Z-HFO-1336mzzm) and isopropanol (IPA). The components within the composition of the present invention are all known chemical substances. Z-HFO-1336mzzm, for example, may be manufactured using the method disclosed in the detailed description within US Published Patent Application 2008-0269532A1.

As acknowledged within the relevant technical field, an azeotrope composition is a mixture of two or more differing substances, which are in liquid format under given pressure conditions, and substantively boil at a specific temperature; wherein, said temperature is either higher or lower than the boiling temperature of the individual components and provides a vapor composition substantially the same as the overall liquid composition during boiling (For example, see M. F. Doherty and M. F. Malone,

CLAIMS

What is claimed is:

1. An azeotrope-like composition, comprising 93.0 – 99.9 mass% Z-1,1,1,4,4,4-hexafluoro-2-butene and 0. 1 - 7 mass% isopropanol.
2. A solid-surface cleaning agent, comprising the azeotrope-like composition according to claim 1.
3. The cleaning agent according to claim 2, wherein the solid-surface is a semiconductor surface.
4. A coolant, comprising the azeotrope-like composition according to claim 1.
5. A foaming agent, comprising the azeotrope-like composition according to claim 1.