their widespread use may also be limited in the future. Thus, there is a need for compositions that do not contribute to the destruction of stratospheric ozone and also have low global warming potentials (GWPs). Certain hydrofluoroolefins, such as 1,1,1,4,4,4-hexafluoro-2-butene ($CF_3CH=CHCF_3$, FC-1336mzz), are believed to meet both goals.

SUMMARY OF THE INVENTION

This application includes eight different types of azeotropic or azeotrope-like mixtures.

This disclosure provides a composition consisting essentially of (a) Z-FC-1336mzz and (b) methyl formate; wherein the methyl formate is present in an effective amount to form an azeotropic or azeotrope-like mixture with Z-FC-1336mzz.

This disclosure also provides a composition consisting essentially of (a) Z-FC-1336mzz and (b) pentane; wherein the pentane is present in an effective amount to form an azeotropic or azeotrope-like mixture with Z-FC-1336mzz.

This disclosure also provides a composition consisting essentially of (a) Z-FC-1336mzz and (b) 2-methylbutane (isopentane); wherein the isopentane is present in an effective amount to form an azeotropic or azeotrope-like mixture with Z-FC-1336mzz.

This disclosure also provides a composition consisting essentially of (a) Z-FC-1336mzz and (b) 1,1,1,3,3-pentafluorobutane ($CF_3CH_2CF_2CH_3$, HFC-365mfc); wherein the HFC-365mfc is present in an effective amount to form an azeotrope-like mixture with Z-FC-1336mzz.

This disclosure also provides a composition consisting essentially of (a) Z-FC-1336mzz and (b) trans-1,2-dichloroethylene; wherein the trans-1,2-dichloroethylene is present in an effective amount to form an azeotropic or azeotrope-like mixture with Z-FC-1336mzz.

One aspect of the invention relates to ~~This disclosure also provides~~ a composition consisting essentially of (a) Z-FC-1336mzz and (b) 1,1,1,3,3-pentafluoropropane ($CF_3CH_2CF_2H$,

HFC-245fa); wherein the HFC-245fa is present in an effective amount to form an azeotrope-like mixture with Z-FC-1336mzz.

Another aspect relates to a process for preparing a thermoplastic or thermoset foam comprising using the azeotrope-like composition as defined above as a blowing agent.

Another aspect relates to a process for producing refrigeration comprising condensing the azeotrope-like composition as defined above and thereafter evaporating said azeotrope-like composition in the vicinity of the body to be cooled.

Another aspect relates to a process comprising using the azeotrope-like composition as defined above as a solvent.

Another aspect relates to a process for producing an aerosol product comprising using the azeotrope-like composition as defined above as a propellant.

Another aspect relates to a process comprising using the azeotrope-like composition as defined above as a heat transfer media.

Another aspect relates to a process for extinguishing or suppressing a fire comprising using the azeotrope-like composition as defined above as a fire extinguishing or suppression agent.

Another aspect relates to a process comprising using the azeotrope-like composition as defined above as dielectrics.

This disclosure also provides a composition consisting essentially of (a) Z-FC-1336mzz and (b) dimethoxymethane ($CH_3OCH_2OCH_3$, methylal); wherein the dimethoxymethane is present in an effective amount to form an azeotrope-like mixture with Z-FC-1336mzz.

This disclosure also provides a composition consisting essentially of (a) Z-FC-1336mzz and (b) cyclopentane (c-C_5H_{10}); wherein the cyclopentane is present in an effective amount to form an azeotropic or azeotrope-like mixture with Z-FC-1336mzz.

BRIEF SUMMARY OF THE DRAWINGS

FIG. 1 - FIG. 1 is a graphical representation of an azeotrope and azeotrope-like compositions consisting essentially of Z-FC-1336mzz and methyl formate at a temperature of about 50.1 °C.

FIG. 2 - FIG. 2 is a graphical representation of an azeotrope and azeotrope-like compositions consisting essentially of Z-FC-1336mzz and pentane at a temperature of about 19.9 °C.

FIG. 3 - FIG. 3 is a graphical representation of an azeotrope and azeotrope-like compositions consisting essentially of Z-FC-1336mzz and isopentane at a temperature of about 19.9 °C.

FIG. 4 - FIG. 4 is a graphical representation of azeotrope-like compositions consisting essentially of Z-FC-1336mzz and HFC-365mfc at a temperature of about 50.0 °C.

FIG. 5 - FIG. 5 is a graphical representation of an azeotrope and azeotrope-like compositions consisting essentially of Z-FC-1336mzz and trans-1,2-dichloroethylene at a temperature of about 50.1 °C.

CLAIMS

1. A composition consisting essentially of:

(a) Z-1,1,1,4,4,4-hexafluoro-2-butene; and

(b) 1,1,1,3,3-pentafluoropropane; wherein the 1,1,1,3,3-pentafluoropropane is present in an effective amount to form an azeotrope-like combination with the Z-1,1,1,4,4,4-hexafluoro-2-butene.

2. The azeotrope-like composition of claim 1 consisting essentially of from 1 to 58 weight percent Z-1,1,1,4,4,4-hexafluoro-2-butene and from 99 to 42 weight percent 1,1,1,3,3-pentafluoropropane, characterized by: at a temperature of from -40 °C to 120 °C, said composition having a difference in dew point pressure and bubble point pressure of less than or equal to 5 percent based upon the bubble point pressure.

3. The azeotrope-like composition of claim 1 consisting essentially of from 76 to 99 weight percent Z-1,1,1,4,4,4-hexafluoro-2-butene and from 24 to 1 weight percent 1,1,1,3,3-pentafluoropropane, characterized by: at a temperature of from -40 °C to 120 °C, said composition having a difference in dew point pressure and bubble point pressure of less than or equal to 5 percent based upon the bubble point pressure.

4. A process for preparing a thermoplastic or thermoset foam comprising using an azeotrope-like composition as a blowing agent, wherein said azeotrope-like composition consists essentially of Z-1,1,1,4,4,4-hexafluoro-2-butene and 1,1,1,3,3-pentafluoropropane.

5. A process for producing refrigeration comprising condensing an azeotrope-like composition and thereafter evaporating said azeotrope-like composition in the vicinity of the body to be cooled, wherein said azeotrope-like composition consists essentially of Z-1,1,1,4,4,4-hexafluoro-2-butene and 1,1,1,3,3-pentafluoropropane.

6. A process comprising using an azeotrope-like composition as a solvent, wherein said azeotrope-like composition consists essentially of Z-1,1,1,4,4,4-hexafluoro-2-butene and 1,1,1,3,3-pentafluoropropane.

7. A process for producing an aerosol product comprising using an azeotrope-like composition as a propellant, wherein said azeotrope-like composition consists essentially of Z-1,1,1,4,4,4-hexafluoro-2-butene and 1,1,1,3,3-pentafluoropropane.
8. A process comprising using an azeotrope-like composition as a heat transfer media, wherein said azeotrope-like composition consists essentially of Z-1,1,1,4,4,4-hexafluoro-2-butene and 1,1,1,3,3-pentafluoropropane.
9. A process for extinguishing or suppressing a fire comprising using an azeotrope-like composition as a fire extinguishing or suppression agent, wherein said azeotrope-like composition consists essentially of Z-1,1,1,4,4,4-hexafluoro-2-butene and 1,1,1,3,3-pentafluoropropane.
10. A process comprising using an azeotrope-like composition as dielectrics, wherein said azeotrope-like composition consists essentially of Z-1,1,1,4,4,4-hexafluoro-2-butene and 1,1,1,3,3-pentafluoropropane.

CLAIMS

1. A composition consisting essentially of:

(a) Z-1,1,1,4,4,4-hexafluoro-2-butene; and

(b) 1,1,1,3,3-pentafluoropropane;

wherein said 1,1,1,3,3-pentafluoropropane is present in an effective amount to form an azeotrope-like combination with the Z-1,1,1,4,4,4-hexafluoro-2-butene.

2. A process for preparing a thermoplastic or thermoset foam comprising using the azeotrope-like composition of claim 1 as a blowing agent.

3. A process for producing refrigeration comprising condensing the azeotrope-like composition of claim 1 and thereafter evaporating said azeotrope-like composition in the vicinity of the body to be cooled.

4. A process comprising using the azeotrope-like composition of claim 1 as a solvent.

5. A process for producing an aerosol product comprising using the azeotrope-like composition of claim 1 as a propellant.

6. A process comprising using the azeotrope-like composition of claim 1 as a heat transfer media.

7. A process for extinguishing or suppressing a fire comprising using the azeotrope-like composition of claim 1 as a fire extinguishing or suppression agent.

8. A process comprising using the azeotrope-like composition of claim 1 as dielectrics.

9. The azeotrope-like composition of claim 1 consisting essentially of from 1 to 58 weight percent Z-1,1,1,4,4,4-hexafluoro-2-butene and from 99 to 42 weight percent 1,1,1,3,3-pentafluoropropane, characterized by: at a temperature of from −40° C. to 120° C., said composition having a difference in dew point pressure and bubble point pressure of less than or equal to 5 percent based upon the bubble point pressure.

10. The azeotrope-like composition of claim 1 consisting essentially of from 76 to 99 weight percent Z-1,1,1,4,4,4-hexafluoro-2-butene and from 24 to 1 weight percent 1,1,1,3,3-pentafluoropropane, characterized by: at a temperature of from −40° C. to 120° C., said composition having a difference in dew point pressure and bubble point pressure of less than or equal to 5 percent based upon the bubble point pressure.