

CLAIMS:

~~1. An adsorption system, comprising:~~

- ~~(a) a vessel containing a protected solid adsorbent comprising a solid adsorbent substrate having a protective surface layer at least partially coating the solid adsorbent substrate, the surface layer being (i) a nanolayer having a thickness of less than 60 nm, (ii) permeable to an active agent that can to penetrate the surface layer and adsorb onto the solid adsorbent substrate and reversibly bind to the solid adsorbent substrate and (iii) capable of preventing interaction or reaction between a heating or cooling fluid and the solid adsorbent substrate;~~
- ~~(b) a supply of working fluid in fluid communication with the vessel, the working fluid including the active agent; and~~
- ~~(c) a supply of heating or cooling fluid in fluid communication with the vessel.~~

2. The adsorption system of claim 1, wherein the active agent is a gas.

3. The adsorption system of claim 2, wherein the active agent is carbon dioxide, methane, ethane, propane, butane or a chlorofluorocarbon

4. The adsorption system of claim 4, wherein the heating or cooling fluid is an aqueous fluid and the surface layer is a hydrophobic layer

5. The adsorption system of claim 1 in which the surface layer comprises an organometallic compound.

6. The adsorption system of claim 8, wherein the organometallic compound is octadecyl-trichlorosilane.

7. A heat-to-cooling or heat-to-power process in which direct heating or cooling of a solid adsorbent material with a heating or cooling fluid is provided in which the solid adsorbent material comprises a solid adsorbent substrate having a protective surface layer at least partially coating the solid adsorbent substrate, the surface layer being (i) a nanolayer having a thickness of less than 60 nm, (ii) permeable to an active agent that can penetrate the surface

~~layer and adsorb onto the solid adsorbent substrate and reversibly bind to the solid adsorbent substrate and (iii) capable of preventing interaction or reaction between the heating or cooling fluid and the solid adsorbent substrate.~~

8. A process according to claim 7 in which the active agent is a gas.

9. The process of claim 8, wherein the active agent is carbon dioxide, methane, ethane, propane, butane or a chlorofluorocarbon

10. The process of claim 7, wherein the heating or cooling fluid is an aqueous fluid and the surface layer is a hydrophobic layer.

11. The process of claim 7 in which a feed containing both the heating or cooling fluid and the working fluid containing the active agent is admitted together to contact the protected solid adsorbent.

12. The process of claim 7 in which the active fluid adsorbed onto the solid adsorbent substrate is desorbed by the heating or cooling fluid and directed to a driver device.

13. The process of claim 7 in which the active fluid adsorbed onto the solid adsorbent substrate is desorbed by the heating or cooling fluid and directed through an expansion valve to provide chilling.

CLAIMS:

1. An adsorption system, comprising:
 - (a) a vessel containing a protected solid adsorbent,
 - (b) a supply of heating/cooling fluid in fluid communication with the adsorbent in the vessel,
 - (c) a supply of working fluid comprising an active agent that can reversibly bind to the solid adsorbent by adsorption, and
 - (d) a means for supplying heat to the heating/cooling fluid, the protected solid adsorbent comprising a solid adsorbent substrate and a surface layer which protects the solid adsorbent from interaction with the heating/cooling fluid and is permeable to the active agent to permit the active agent to penetrate the surface layer and adsorb onto the solid adsorbent.
2. The adsorption system of claim 1, wherein the heating/cooling fluid and the working fluid are added together in the vessel.
3. The adsorption system of claim 1, wherein the active agent is CO₂.
4. The adsorption system of claim 1, further comprising an expansion valve in fluid communication with the vessel.
5. The adsorption system of claim 1, further comprising a turboexpander in fluid communication with the vessel.
6. The adsorption system of claim 1, wherein the means for supplying heat is a source of waste heat.
7. The adsorption system of claim 1, wherein the surface layer is a nano layer.

8. The adsorption system of claim 1, wherein the surface layer is hydrophobic.

9. The adsorption system of claim 1, wherein the surface layer comprises an organometallic compound.

10. The adsorption system of claim 1, wherein the organometallic compound is octodecyltrichlorosilane.

11. The adsorption system of claim 1, wherein the solid adsorbent substrate is a zeolite.

12. The adsorption system of claim 11, wherein the zeolite is zeolite 13X.

13. The adsorption system of claim 1 in which the solid adsorbent comprises a monolith.