CLAIMS:

~~1. A structured adsorbent particle comprising a thin film adsorbent coating on the exterior of a low permeability core (*e.g.*, a substantially non-permeable, solid core), wherein a minimum cross-sectional dimension of the particle is less than 1 centimeter and greater than 100 microns.~~

~~2. A structured adsorbent particle according to claim 1, wherein the adsorbent coating has a thickness less than 1000 microns and greater than 1 micron, said thickness representing an average thickness whose uniformity is optionally such that a thickness standard deviation is less than about 40% of the average thickness.~~

~~3. A structured adsorbent particle according to any one of the preceding claims, wherein the adsorbent coating comprises a microporous material (*e.g.*, selected from zeolites, such as selected from DDR, CHA, MFI, Beta, FAU, and combinations and intergrowths thereof; MOFs (metal organic frameworks); AlPOs; SAPOs; ZIFs (zeolitic imidazolate frameworks); and carbons), comprises a mixed matrix material (*e.g.*, a polymer film comprising a polymer selected from silicone rubber and polyimides, and further comprising particles of zeolite, such as selected from DDR, CHA, MFI, Beta, FAU, and combinations and intergrowths thereof), and/or is comprised of an intergrown film of adsorbent crystals (*e.g.*, comprised of a zeolite selected from DDR, MFI, CHA, and combinations and intergrowths thereof) grown directly on the exterior surface of the low permeability core.~~

~~4. A structured adsorbent particle according to one of the preceding claims, wherein a ratio of a length to maximum cross-sectional dimension of the particle is at least 5:1.~~

~~5. A structured adsorbent module comprising a multitude of adsorbent particles (such as adsorbent particles according to one or more of claims 1-5) arranged in a mass, wherein the adsorbent particles are oriented in a substantially similar direction, which mass is supported in a module configuration to substantially maintain the orientation of the adsorbent particles therein, and wherein the adsorbent particles have a ratio of a length to maximum cross-sectional dimension of at least 2:1, *e.g.*, at least 5:1.~~

~~6. A structured adsorbent module according to claim 5, wherein the mass is supported in a module configuration by an external support and/or by cohering the particles in the mass.~~

~~7. A structured adsorbent module according to claim 5 or claim 6, wherein the adsorbent particle is comprised of a thin film adsorbent coating on the exterior of a low permeability core (*e.g.*, a substantially non-permeable, solid core), wherein a minimum cross-sectional dimension of the particle is less than 1 centimeter and greater than 100 microns.~~

~~8. A structured adsorbent module according to claim 7, wherein the adsorbent coating has a thickness less than 1000 microns and greater than 1 micron (wherein said thickness represents an average thickness whose uniformity is optionally such that its standard deviation is less than about 40% of the average thickness) and/or comprises a microporous material (*e.g.*, selected from zeolites, such as selected from DDR, CHA, MFI, Beta, FAU, and combinations and intergrowths thereof; MOFs (metal organic frameworks); AlPOs; SAPOs; ZIFs (zeolitic imidazolate frameworks); and carbons), comprises a mixed matrix material (*e.g.*, a polymer film comprising a polymer selected from silicone rubber and polyimides, and further comprising particles of zeolite, such as selected from DDR, CHA, MFI, Beta, FAU, and combinations and intergrowths thereof), and/or is comprised of an intergrown film of adsorbent crystals (*e.g.*, comprised of a zeolite selected from DDR, MFI, CHA, and combinations and intergrowths thereof) grown directly on the exterior surface of the low permeability core.~~

~~9. A structured adsorbent module according to any of claims 5-8, wherein an end-to-end dimension of the module (in the direction of adsorbent preferred longitudinal orientation of the particles) is from about 5 cm to about 100 cm.~~

~~10.~~1. A gas separation process comprising contacting a gas mixture containing at least one contaminant with an adsorbent bed ~~(such as the adsorbent module according to any one of claims 5-9)~~ of structured adsorbent particles ~~(such as adsorbent particles according to any one of claims 1-4)~~ comprising a thin film adsorbent coating on ~~an~~ the exterior of a low permeability core ~~(*e.g.*, a substantially non-permeable, solid core)~~,

wherein the adsorbent particles have:

(i) a minimum cross-sectional dimension of ~~the particles is~~ less than 1 centimeter and greater than 100 microns~~.~~;

(ii) a length to maximum cross-sectional dimension of at least 2:1; and

(iii) a longitudinal dimension of at least 20 mm; and

wherein the adsorbent particles are positioned in the adsorbent bed with a void fraction not more than 30%, and in an ordered configuration to provide substantially longitudinally extensive, substantially aligned gas channels by which the gas mixture to be separated can access the adsorbent material along the length of at least a proportion of the particles to cause adsorption of at least some of the contaminants and to form a purified gas product having a reduced content of the adsorbed contaminant material.

2. A process according to claim 1, wherein the core is a substantially non-permeable, solid core.

~~11.~~3. A process according to claim ~~10~~ 1, wherein the adsorbent coating has a thickness of less than 1000 microns and greater than 1 micron, ~~(wherein said~~ which coating thickness ~~represents an average thickness whose~~ also has a uniformity ~~is optionally~~ such that ~~its~~ a thickness standard deviation is less than about 40% of the ~~average~~ thickness.~~), *e.g.*, less than 500 microns and greater than 25 microns, and/or comprises a microporous material and/or a mixed matrix material.~~

4. A process according to claim 3, wherein the adsorbent coating has a thickness of less than 500 microns and greater than 25 microns.

5. A process according to claim 1, wherein the adsorbent coating comprises a microporous material.

~~12. A process according to claim 10 or claim 11, wherein the adsorbent particles have a length to maximum cross-sectional dimension of the particle of at least 2:1, *e.g.*, of at least 5:1, and are positioned in the adsorbent bed with a void fraction not more than 30%, and in an ordered configuration to provide substantially longitudinally extensive, substantially aligned gas channels by which the gas mixture to be separated can access the adsorbent material along the length of at least a proportion of the particles to cause adsorption of at least some of the contaminants and to form a purified gas product having a reduced content of the adsorbed contaminant material.~~

6. A process according to claim 5, wherein the microporous material is selected from zeolites, MOFs (metal organic frameworks), AlPOs, SAPOs, ZIFs (zeolitic imidazolate frameworks), carbons and combinations and intergrowths thereof.

7. A process according to claim 6, wherein the microporous material is a zeolite selected from DDR, CHA, MFI, Beta, FAU, and combinations and intergrowths thereof.

8. A process according to claim 1, wherein the adsorbent coating comprises a mixed matrix material.

9. A process according to claim 8, wherein the mixed matrix material is a polymer film comprising a polymer selected from silicone rubber and polyimides, and further comprises particles of zeolite.

10. A process according to claim 9, wherein the zeolite is selected from DDR, CHA, MFI, Beta, FAU, and combinations and intergrowths thereof.

~~13.~~11. A process according to ~~any one of claims 10-12~~ claim 1, wherein the ordered adsorbent bed of particulate adsorbent particles comprises locally structured ordered regions in which the particulate adsorbent particles are laid down in ~~an~~ the ordered configuration of substantially longitudinally extensive, substantially aligned gas channels.

12. A process according to claim 11, further comprising adhering the adsorbent particles together with an adhesive to form the locally structured ordered regions and removing the adhesive prior to contact with the gas stream.

13. A process according to claim 12, further comprising applying the adhesive to the adsorbent particles by spraying the adsorbent particles with the adhesive or passing the adsorbent particles through a bath of the adhesive.

14. A process according to claim 11, where an end-to-end dimension of the locally structured ordered regions is from about 5 cm to about 100 cm.

~~14.~~15. A process according to ~~any one of claims 10-13~~ claim 1, wherein the adsorbent particles are in the form of hollow cylinders or hollow prismatic polygonal shapes having a central gas passage~~, or prismatic polygonal shapes having cross-sectional irregularities (*e.g.*, comprising irregular lengths of polygonal sides or irregular vertex angles) that preclude maximal face-to-face contact of the particles in the ordered configuration.~~

16. A process according to claim 1, wherein the adsorbent particles are in the form of prismatic polygonal shapes having cross-sectional irregularities that preclude maximal face-to-face contact of the particles in the ordered configuration.

17. A process according to claim 16, wherein the cross-sectional irregularities comprise irregular lengths of polygonal sides and/or irregular vertex angles.

~~15.~~18. A process according to ~~any one of claims 10-14~~ claim 1, wherein the adsorbent particles have surface irregularities in the form of uniform roughness that precludes maximal face-to-face contact of the particles in the ordered configuration. ~~and/or have a longitudinal dimension of at least 20 mm.~~

19. A process according to claim 1, wherein the adsorbent particles have a length to maximum cross-sectional dimension of the particle of at least 5:1.

~~16.~~20. A process according to ~~any one of claims 10-15~~ claim 1, wherein the gas mixture is natural gas and the at least one contaminant is CO_2, H_2S, or a combination thereof. ~~, and/or wherein the gas mixture is natural gas.~~

21. A process according to claim 1, wherein the at least one contaminant is CO_2, H_2S, or a combination thereof.

22. A process according to claim 1, further comprising growing an intergrown film of adsorbent crystals directly on the exterior surface of the low permeability core to form the adsorbent coating.

23. A process according to claim 22, wherein the adsorbent crystals are comprised of a zeolite selected from DDR, MFI, CHA, and combinations and intergrowths thereof.

24. A process according to claim 1, wherein the adsorbent particles comprise an exterior longitudinal groove.

25. A process according to claim 1, wherein the adsorbent particles have a central gas passage and an exterior gas passage and the interior and exterior surfaces of the adsorbent particles comprise the adsorbent coating.

26. A process according to claim 1, further comprising wash coating individual bound particles on the core to form the adsorbent coating.

27. A process according to claim 1, further comprising forming a porous inorganic oxide film on the surface of the core and imbibing an adsorbent liquid into the pore structure of the inorganic oxide film to form the adsorbent coating.

~~17. A kinetic gas separation process which comprises contacting a stream of a gas mixture comprising natural gas containing contaminants including carbon dioxide and/or hydrogen sulfide, with an ordered adsorbent bed having a void fraction of not~~

~~more than 33% and being comprised of adsorbent particles laid down in the adsorbent bed in an ordered configuration to provide substantially longitudinally extensive, substantially aligned gas channels by which the gas mixture contacts the adsorbent material along the length of at least a proportion of the particles to cause adsorption of at least some of the contaminants and to form a purified natural gas product having a reduced content of the adsorbed contaminant material.~~

~~18. A kinetic gas separation process according to claim 17, wherein the gas stream is contacted with locally structured regions of the adsorbent particles (*e.g.*, formed by adhering together the particles with an adhesive which is removed prior to contact with the gas stream) laid down in the adsorbent bed in an ordered configuration to provide the substantially longitudinally extensive, substantially aligned gas channels to cause adsorption of at least some of the contaminants and to form a purified natural gas product having a reduced content of the adsorbed contaminant material.~~

~~19. A method of forming an adsorbent bed of ordered adsorbent particles for treating a gas stream to remove gaseous contaminants from the stream, which comprises laying the adsorbent particles down in a mass in an ordered configuration to provide substantially longitudinally extensive, substantially aligned gas channels by which the gas mixture contacts the adsorbent material along the length of at least a proportion of the particles, cohering the particles in the mass (*e.g.*, by laying down the particles in the ordered configuration in a container and/or by laying down the particles in the ordered configuration and adhering the particles together, such as by means of an adhesive) to form a coherent, self-supporting mass and assembling a plurality of the masses in an adsorption vessel to form an ordered adsorbent bed.~~

~~20. A method of making a simulated adsorbent monolith for separating components of a gas stream, which comprises:~~

~~(i) forming a coat of a adsorbent material which is selective for adsorption of at least one of the components of the gas stream on the outsides of solid, non-porous particles having a length to maximum cross-sectional dimension ratio of at least 2:1 and a maximum cross-sectional dimension of not more than 1 mm;~~

~~(ii) laying the adsorbent particles down in a mass in an ordered configuration with substantially longitudinally extensive, substantially aligned gas channels by~~

~~which the gas stream may contact the adsorbent material along the length of at least a proportion of the particles;~~

~~(iii) externally supporting or cohering the particles in the mass to form a coherent, self-supporting mass; and~~

~~(iv) assembling a plurality of the masses in an adsorption vessel to form an ordered adsorbent bed.~~