CLAIMS

1. An adsorbent composition comprising a bismuth material, a promoter, and a support, wherein the support comprises particles having a particle size of from about 1 μm to 10 mm, wherein the bismuth material and the promoter are each dispersed within pores of the support via incipient-wetness impregnation of precursors of the bismuth material and the promoter onto the support, wherein the promoter comprises a tungsten material, and wherein:

the bismuth material is present as bismuth oxide from about 2 wt% to about 20 wt% on a bismuth metal basis, based on the total weight of the adsorbent composition,

the promoter is present from about 1 wt% to about 11 wt%, based on the total weight of the adsorbent composition, and

the balance of the weight of the adsorbent composition consists essentially of the support, the support being selected from a titanium oxide, an aluminum oxide, activated carbon, or a molecular sieve.

2. The adsorbent composition according to claim 1, wherein the bismuth material comprises bismuth (III) oxide (Bi_2O_3).

3. The adsorbent composition according to claim 1, wherein the support comprises titanium dioxide or anatase titanium dioxide.

4. The adsorbent composition according to claim 1, wherein the support comprises aluminum oxide or titanium oxide.

5. The adsorbent composition according to claim 1, wherein the support has a surface area of from about 10 m^2/g to about 600 m^2/g.

6. The adsorbent composition according to claim 1, wherein the composition further comprises ≤ 20 wt% lead oxide, based on the total weight of the composition.

7. The adsorbent composition according to claim 1, wherein the adsorbent composition is substantially free of lead.

8. The adsorbent composition according to claim 1, wherein the composition is in a form selected from a group consisting of tablets, extrudates, pellets, rods, moldings and monoliths, and wherein the composition further comprises one or more compounds selected from a group consisting of silver oxide, iron oxide, manganese oxide, cerium oxide, vanadium oxide, tin oxide and niobium oxide.

9. The adsorbent composition according to claim 1, wherein the support has a pore volume of from about 0.01 cm^3/g to about 5.0 cm^3/g, and wherein the support contains pores having an average pore size of from about 1 Å to about 750 Å.

10. The adsorbent composition according to claim 1, wherein the promoter is tungsten oxide and the support is titania.

11. The adsorbent composition according to claim 1, having an arsine removal efficiency of ≥ 90%, as measured by a dry colorimetry method using an arsine analyzer.

12. The adsorbent composition according to claim 1, which exhibits an improved arsine removal efficiency of ≥ 15% compared to the same composition not containing the promoter, as measured by a dry colorimetry method using an arsine analyzer.

13. A method of preparing an adsorbent composition comprising a bismuth material, a promoter, and a support, the method comprising dispersing a bismuth precursor and a promoter precursor into pores of the support via incipient wetness impregnation, wherein the promoter or the promoter precursor comprises a silicon material or a tungsten material.

14. An adsorbent composition consisting essentially of bismuth oxide, tungsten oxide, and titania support particles, wherein a particle size of the titania support particles is from about 1 μm to 10 mm.