CLAIMS

What is claimed is:

1. A method of synthesizing sodium titanate, the method comprising the steps of:

providing at least one source of titanium that includes nano-crystalline titanium having a mean primary crystallite diameter of ~~about~~ 1 nm to ~~about~~ 30 nm;

providing at least one source of sodium oxide;

forming a reaction mixture that includes the at least one source of titanium and the at least one source of sodium oxide in a suitable solvent; and

reacting the components of the reaction mixture to produce a reaction product that includes sodium titanate having a particle size ranging from 1 micron to 100 microns.

2. The method of claim 1, wherein the nano-crystalline titanium has a mean primary crystallite diameter of ~~about~~ 1 nm to ~~about~~ 10 nm.

3. The method of claim 1, wherein the nano-crystalline titanium is a titanium oxide or a titanium hydroxide.

4. The method of claim 3, wherein the nano-crystalline titanium is titanium dioxide.

5. The method of claim 1, wherein the at least one source of sodium oxide is selected from the group consisting of sodium hydroxide, sodium silicate, and alkali metal hydroxide.

6. The method of claim 1, wherein the sodium titanate has an average particle size from ~~about~~ 20 microns to ~~about~~ 70 microns.

7. The method of claim 1, wherein the sodium titanate has a surface area of at least $200m^2/g$.

8. The method of claim 1, wherein the step of reacting comprises reacting the components of the reaction mixture for a reaction period having a length of time from ~~about~~ 1 hours to ~~about~~ 60 hours.

9. The method of claim 1, wherein the step of reacting comprises heating the reaction mixture to a temperature from ~~about~~ 50° C to ~~about~~ 140° C.

10. The method of claim 1, wherein the step of reacting comprises stirring the reaction mixture with high shear mixing.

11. The method of claim 1, wherein the step of reacting comprises:

reacting the components of the reaction mixture for a reaction period having a length of time from ~~about~~ 1 hours to ~~about~~ 60 hours;

heating the reaction mixture to a temperature from ~~about~~ 50° C to ~~about~~ 140° C for the reaction period; and

stirring the reaction mixture with high shear mixing for the reaction period.

12. The method of claim 1, wherein the method further comprises:

adjusting the pH of the reaction product with an acid;

rinsing the reaction product with deoinized water; and

drying the reaction product.

13. An ion exchange medium comprising sodium titanate produced by the method of claim 1.

14. A method of removing contaminants from water, the method comprising the steps of:

providing an ion exchange medium to a treatment vessel, the ion exchange medium comprising sodium titanate synthesized by:

providing at least one source of titanium that includes nano-crystalline titanium having a mean primary crystallite diameter of ~~about~~ 1 nm to ~~about~~ 30 nm;

providing at least one source of sodium oxide;

forming a reaction mixture that includes the at least one source of titanium and the at least one source of sodium oxide in a suitable solvent; and

reacting the components of the reaction mixture to produce a reaction product that includes sodium titanate having a particle size ranging from 1 micron to 100 microns;

providing water from a water source to the treatment vessel; and

passing the water through the sodium titanate ion exchange medium in the treatment vessel to remove at least one contaminant.

15. The method of claim 14, wherein the nano-crystalline titanium is a titanium oxide or a titanium hydroxide.

16. The method of claim 15, wherein the nano-crystalline titanium is titanium dioxide.

17. The method of claim 14, wherein the sodium titanate has an average particle size from ~~about~~ 20 microns to ~~about~~ 70 microns.

18. The method of claim 14, wherein the sodium titanate has a surface area of at least $200m^2/g$.

19. The method of claim 14, wherein the at least one contaminant comprises a metal.

20. The method of claim 14, wherein the metal is lead.

21. The method of any one of claims 1 and 14, wherein the at least one source of sodium oxide includes sodium hydroxide (NaOH) and Sodium Silicate (Na_2SiO_3), and the sodium titanate is synthesized in accordance with the following reaction formula:

$$2\ TiO_2 + 2\ NaOH + Na_2SiO_3 = 2\ Na_2TiO_3 + H_2O + SiO_2.$$

22. The method of claim 14, wherein the step of providing an ion exchange medium to a treatment vessel further comprises steps of:

adding sodium silicate to the reaction product; and

forming an ion exchange product comprising from about 20 wt% to about 90 wt% sodium titanate, from about 0 wt% to about 60 wt% sodium hydroxide, from about 0 wt% to about 20 wt% sodium silicate, from about 0 wt% to about 10 wt% sodium sulfate, and from about 5 wt% to about 10 wt% water.