Claims

1. A method for preparing a transition metal nanocomposite, the method comprising:

mixing a transition metal hydroxide and a diamondoid compound having at least one carboxylic acid moiety to form a reactant mixture;

hydrothermally treating the reactant mixture at a reaction temperature for a reaction time to form a transition-metal adamantane carboxylate salt; and

thermally decomposing the transition-metal adamantane carboxylate salt in a reducing atmosphere at a decomposition temperature for a decomposition time to form the transition metal nanocomposite.

2. The method of claim 1, wherein the diamondoid compound is 1-adamantane carboxylic acid and the transition metal hydroxide has an oxidation state of M+2, where M is chosen from cobalt (Co), copper (Cu), or combinations of cobalt and copper.

3. The method of claim 2, wherein the transition metal hydroxide and the 1-adamantane carboxylic acid are mixed in amounts that provide a molar ratio of M^{2+} to 1-adamantane carboxylic acid in the reaction mixture of from 0.5:1 to 1:1.

4. The method of any one of the preceding claims, wherein the reaction temperature is from 100 °C to 180 °C and the reaction time is at least 12 hours.

5. The method of any one of the preceding claims, wherein the transition metal hydroxide is $Co(OH)_2$ or $Cu(OH)_2$ and the reaction temperature is 110 °C.

6. The method of any one of the preceding claims, wherein thermally decomposing the transition-metal adamantane carboxylate salt further comprises heating the transition-metal adamantane carboxylate salt from room temperature to the decomposition temperature at a rate of 5 °C per minute, wherein the decomposition temperature is at least 450 °C, and wherein the decomposition time is at least 4 hours.

7. The method of any one of the preceding claims, wherein the transition metal nanocomposite comprises transition metal oxide particles.

8. The method of any one of the preceding claims, wherein the transition metal nanocomposite comprises from 70 wt.% to 80 wt.% metal oxide and from 20 wt.% to 30 wt.% carbon, based on the total weight of the transition metal nanocomposite.

9. The method of any one of the preceding claims, wherein the transition-metal adamantane carboxylate salt comprises Co-AC.

10. The method of claim 9, wherein the cobalt oxide comprises CoO, Co_3O_4, or a mixture of CoO and Co_3O_4.

11. The method of any one of claims 1−8, wherein the transition-metal adamantane carboxylate salt comprises Ni-AC.

12. The method of claim 11, wherein the transition metal nanocomposite comprises crystallites of NiO configured as porous nanowhiskers.

13. The method of any one of claims 1–8, wherein the transition-metal adamantane carboxylate salt comprises Cu-AC.

14. The method of claim 13, wherein the transition metal nanocomposite comprises carbon sheets and nanoparticles of copper oxide supported on carbon sheets.

15. The method of claim 14, wherein the copper oxide comprises CuO, Cu_2O, or a mixture of CuO and Cu_2O.