CLAIMS

1. A method for preparing mixed-metal oxide Diamondoid nanocomposites, the method comprising:

mixing $Mg(OH)_2$ and $Al(OH)_3$ to form a Mg^{2+}/Al^{3+} solution, in which the Mg/Al has a molar ratio of between 0.5:1 to 6:1;

adding a diamondoid compound to the Mg^{2+}/Al^{3+} solution to form a reactant mixture, in which the diamondoid compound has at least one carboxylic acid moiety;

heating the reactant mixture at a reaction temperature for a reaction time to form a Mg/Al-diamondoid intercalated layered double hydroxide; and

thermally decomposing the Mg/Al- diamondoid intercalated layered double hydroxide under a reducing atmosphere for a decomposition time at a decomposition temperature to form the layered metal nanocomposite.

2. The method of claim 1, in which the $Al(OH)_3$ and the diamondoid compound are mixed in amounts that provide a ratio of Al^{3+} to diamondoid compound in the reactant mixture of from 0.5:1 to 2:1.

3. The method of claim 1, in which the diamondoid compound is 1-adamantane carboxylic acid.

4. The method of claim 1, in which the Mg^{2+}/Al^{3+} solution is an aqueous solution.

5. The method of claim 1, in which the reaction temperature is from 100 °C to 180 °C.

6. The method of claim 1, in which the reaction temperature is from 140 °C to 160 °C.

7. The method of claim 1, in which the decomposition temperature is from 220 °C to 450 °C.

8. The method of claim 1, in which the decomposition temperature is from 300 °C to 450 °C.

9. The method of claim 1, in which the decomposition time is at least 4 hours.

10. The method of claim 1, in which the reducing atmosphere comprises hydrogen gas.

11. The method of claim 1, in which the layered metal nanocomposite comprises a layered morphology of a plurality of octahedral and tetrahedral environments.

12. A mixed-metal oxide Diamondoid nanocomposite prepared by:

mixing $Mg(OH)_2$ and $Al(OH)_3$ to form a Mg^{2+}/Al^{3+} solution, in which the Mg/Al has a molar ratio of between 0.5:1 to 6:1;

adding a diamondoid compound to the Mg^{2+}/Al^{3+} solution to form a reactant mixture, in which the diamondoid compound has at least one carboxylic acid moiety;

heating the reactant mixture at a reaction temperature for a reaction time to form a Mg/Al-diamondoid intercalated layered double hydroxide; and

thermally decomposing the Mg/Al- diamondoid intercalated layered double hydroxide under a reducing atmosphere for a decomposition time at a decomposition temperature to form the layered metal nanocomposite.

13. A catalyst system comprising mixed-metal oxide Diamondoid nanocomposites prepared by:

mixing $Mg(OH)_2$ and $Al(OH)_3$ to form a Mg^{2+}/Al^{3+} solution, in which the Mg/Al has a molar ratio of between 0.5:1 to 6:1;

adding a diamondoid compound to the Mg^{2+}/Al^{3+} solution to form a reactant mixture, in which the diamondoid compound has at least one carboxylic acid moiety;

heating the reactant mixture at a reaction temperature for a reaction time to form a Mg/Al-diamondoid intercalated layered double hydroxide; and

thermally decomposing the Mg/Al- diamondoid intercalated layered double hydroxide under a reducing atmosphere for a decomposition time at a decomposition temperature to form the layered metal nanocomposite.

14. The catalyst system of claim 13, in which the layered metal nanocomposite comprises a Powder X-Ray Diffraction (PXRD) pattern having multiple reflections at lower than 42.71 (2.11 Å) and 62.2° 2θ (1.49 Å).