WHAT IS CLAIMED IS:

1. A metal ion nanocluster having a particle size of 2 to 500 nm, a molecular weight of 3500 to 1000000 Dalton, and a formula of $X(OH)_aY_bZ_cM_d(H_2O)_e$, in which X is a metal cation, Y is a water-soluble salt-forming anion, Z is a water-soluble ligand, M is a turbidity point modifier, a is 0.1 to 20, b is 0 to 9, c is 0.1 to 10, d is 0.1 to 9, and e is 0 to 25,

wherein the metal cation is Mg(II), Al(III), Ca(II), Cr(III), Cu(II), Zn(II), Mn (II), Ti(IV), Fe(II/III), Co(II), Ni(II), Bi(III), V(V), La(III), Mo(VI), Sr(II), Zr(IV) or a combination thereof; the turbidity point modifier is a complex-forming polyvalence anion, a carboxylated polyol, a carboxylated polyether, a sulfonated carbohydrate, a sulfonated polyol, a sulfonated polyether, a phospholated carbohydrate, a phospholated polyol, a phospholated polyether, an amino acid, a water-soluble polypeptide, a water-soluble protein, or a combination thereof; and the nanocluster has a turbidity point of 8 or lower.

2. The nanocluster of claim 1, wherein the particle size is 2 to 150 nm.

3. The nanocluster of claim 2, wherein the particle size is 2 to 80 nm.

4. The nanocluster of claim 1, wherein the water-soluble salt-forming anion is fluoride, chloride, bromide, iodide, nitrate, sulfate, acetate, or a combination thereof; the water-soluble ligand is a carbohydrate, a hydrogenated carbohydrate, a hydrolyzed carbohydrate, a polyol, a polyether, or a combination thereof; and the turbidity point modifier is a complex-forming polyvalence anion.

5. The nanocluster of claim 4, wherein the water-soluble salt-forming anion is chloride, nitrate, sulfate, acetate, or a combination thereof; the water-soluble ligand is xylitol, mannitol, ribose, mannose, xylose, galactose, fructose, lactose, glucose, isomaltose, isomalt, sucrose, maltitol, trehalose, arabinose, sorbitol, polyisomaltose, isomalto-oligosaccharide, dextrin, dextran, fructooligosaccharide, or a combination

thereof; and the complex-forming polyvalence anion is citrate, malate, fumarate, tartrate, lactate, oxalate, succinate, ascorbate, phosphate, pyrophosphate, glycerophosphate, or a combination thereof.

6. The nanocluster of claim 1, wherein the nanocluster has a turbidity point of 4.5 or lower.

7. The nanocluster of claim 1, wherein a is 1 to 10, b is 0 to 3, c is 1 to 6, d is 0.1 to 6, and e is 0 to 10.

8. The nanocluster of claim 1, wherein the nanocluster has a molecular weight of 5000 to 300000 Dalton.

9. The nanocluster of claim 8, wherein the nanocluster has a molecular weight of 10000 to 180000 Dalton.

10. The nanocluster of claim 1, wherein the nanocluster has a dissociation rate of 1 to 180 minutes.

11. The nanocluster of claim 10, wherein the nanocluster has a dissociation rate of 1 to 60 minutes.

12. The nanocluster of claim 1, wherein the nanocluster has a particle size of 2 to 150 nm, a turbidity point of 7 or lower, and a dissociation rate of 1 to 180 minutes; the water-soluble salt-forming anion is fluoride, chloride, bromide, iodide, nitrate, sulfate, acetate, or a combination thereof; the water-soluble ligand is a carbohydrate, a hydrogenated carbohydrate, a hydrolysed carbohydrate, a polyol, a polyether, or a combination thereof; and the turbidity point modifier is a complex-forming polyvalence anion.

13. The nanocluster of claim 12, wherein the nanocluster has a particle size of 2 to 80 nm, a turbidity point of 4.5 or lower, and a dissociation rate of 1 to 60 minutes; the water-soluble salt-forming anion is chloride, nitrate, sulfate, acetate, or a combination thereof; the water-soluble ligand is xylitol, robose, mannose, xylose, galactose, fructose, lactose, glucose, mannitol, maltitol, isomaltose, isomalt, sucrose, trehalose, arabinose, sorbitol, polyisomaltose, isomalto oligosaccharide, dextrin, dextran, fructooligosaccharide, or a combination thereof; and the turbidity point modifier is citrate, malate, fumarate, tartrate, lactate, oxalate, succinate, ascorbate, phosphate, pyrophosphate, glycerophosphate, or a combination thereof.

14. A composition comprising a nanocluster of claim 1, wherein the composition has a pH value of 3 to 11.5 and is free of unchelated ions, unreactive water-soluble ligands, and labile low-molecular-weight ion complexes.

15. The composition of claim 14, wherein the nanocluster has a particle size of 2 to 150 nm, a turbidity point of 7 or lower, and a dissociation rate of 1 to 180 minutes; the water-soluble salt-forming anion is fluoride, chloride, bromide, iodide, nitrate, sulfate, acetate, or a combination thereof; the water-soluble ligand is a carbohydrate, a hydrogenated carbohydrate, a polyol, a polyether, or a combination thereof; and the turbidity point modifier is a complex-forming polyvalence anion.

16. The composition of claim 15, wherein the nanocluster has a particle size of 2 to 80 nm, a turbidity point of 4.5 or lower, and a dissociation rate of 1 to 60 minutes; the water-soluble salt-forming anion is chloride, nitrate, sulfate, acetate, or a combination thereof; the water-soluble ligand is xylitol, robose, mannose, xylose, galactose, fructose, lactose, glucose, mannitol, maltitol, isomaltose, isomalt, sucrose, trehalose, arabinose, sorbitol, polyisomaltose, isomalto-oligosaccharide, dextrin, dextran, fructooligosaccharide, or a combination thereof; and the turbidity point modifier is citrate, malate, lactate, fumarate, tartrate, oxalate, succinate, ascorbate, phosphate, pyrophosphate, glycerophosphate, or a combination thereof.

17. The composition of claim 14, wherein the pH value is 3.5 to 9.

18. The composition of claim 17, wherein the nanocluster has a particle size of 2 to 150 nm, a turbidity point of 7 or lower, and a dissociation rate of 1 to 180 minutes; the water-soluble salt-forming anion is fluoride, chloride, bromide, iodide, carbonate, bicarbonate, hydroxide, nitrate, phosphate, pyrophosphate, sulfate, acetate, or a combination thereof; the water-soluble ligand is a carbohydrate, a hydrogenated carbohydrate, a polyol, a polyether, or a combination thereof; and the turbidity point modifier is a complex- forming polyvalence anion.

19. The composition of claim 18, wherein the nanocluster has a particle size of 2 to 80 nm, a turbidity point of 4.5 or below, and a dissociation rate of 1 to 60 minutes; the water-soluble salt-forming anion is chloride, nitrate, sulfate, acetate, or a combination thereof; the water-soluble ligand is xylitol, robose, mannose, xylose, galactose, fructose, lactose, glucose, mannitol, maltitol, isomaltose, isomalt, sucrose, trehalose, arabinose, sorbitol, polyisomaltose, isomalto-oligosaccharide, dextrin, dextran, fructooligosaccharide, or a combination thereof; and the turbidity point modifier is citrate, malate, fumarate, tartrate, oxalate, succinate, ascorbate, phosphate, pyrophosphate, glycerophosphate, or a combination thereof.

20. The composition of claim 14, wherein the composition is a transparent aqueous solution or a water-soluble solid capable of being reconstituted into a transparent aqueous solution, the transparent aqueous solution having a pH value of 3.5-9.5.

21. The composition of claim 20, wherein the nanocluster has a particle size of 2 to 150 nm, a turbidity point 7 or lower, and a dissociation rate of 1 to 180 minutes; the water-soluble salt-forming anion is fluoride, chloride, bromide, iodide, nitrate, sulfate, acetate, or a combination thereof; the water-soluble ligand is a carbohydrate, a hydrogenated carbohydrate, a polyol, a polyether, or a combination thereof; and the turbidity point modifier is a complex-forming polyvalence anion.

22. The composition of claim 21, wherein the nanocluster has a particle size of 2 to 80 nm, a turbidity point of 4.5 or lower, and a dissociation rate of 1 to 60 minutes; the water-soluble salt-forming anion is chloride, nitrate, sulfate, acetate, or a combination thereof; the water-soluble ligand is xylitol, robose, mannose, xylose, galactose, fructose, lactose, glucose, mannitol, maltitol, isomaltose, isomalt, sucrose, trehalose, arabinose, sorbitol, polyisomaltose, isomalto oligosaccharide, dextrin, dextran, fructooligosaccharide, or a combination thereof; and the turbidity point modifier is citrate, malate, fumarate, tartrate, lactate, oxalate, succinate, ascorbate, phosphate, pyrophosphate, glycerophosphate, or a combination thereof.

23. A method of preparing a nanocluster of claim 1, the method comprising:

providing an aqueous dispersion containing X, Y, Z, and OH;

adjusting the pH of the aqueous dispersion to a predetermined value to obtain a pH-adjusted aqueous dispersion;

heating the pH-adjusted aqueous dispersion to 50-180°C so that nanoclusters are formed; and

adding M after any of the above steps,

wherein X is a metal cation, Y is a water-soluble salt-forming anion, Z is a water-soluble ligand, M is a turbidity point modifier, and the ratio of X : Y : Z : M is 1 : 0-9 : 0.1-10 : 0.1-9.

24. The method of claim 23, further comprising, after M is added and the nanoclusters are formed, collecting the nanoclusters by nanofiltration and drying the nanoclusters to form solid nanoclusters.