Summary

The present disclosure relates to a coating formulation comprising:

a) an inorganic oxygen scavenger;
b) a surfactant;
c) an activator;
d) a hydrophilic agent;
e) optionally an additive; and
f) a polymeric matrix.

In one aspect, the present disclosure relates to a coating formulation comprising:

a) an inorganic oxygen scavenger;
b) a surfactant comprising natural clay, synthetic clay or modified clay;
c) an activator;
d) a hydrophilic agent selected from a polymer comprising monomers selected from an alkylene oxide, a carboxylic acid and combinations thereof;
e) an additive being ascorbic acid; and

a polymeric matrix.

Advantageously, the inorganic oxygen scavenger such as iron based oxygen scavenger is widely available and with high scavenging efficiency. The surfactant may aid in enhancing the dispersion of the inorganic oxygen scavenger and the activator into the polymer matrix. The introduction of the hydrophilic agent can improve the moisture permeability of the polymer matrix and further improve the oxygen scavenging performance. Finally, the addition of additive may aid in enhancing the scavenging performance of the inorganic oxygen scavenger by regenerating the inorganic oxygen scavenger after oxidation.

Further advantageously, the coating formulation can be applied as part of plastic packaging (which are typically used to package food or beverages), with high transparency and without odor after oxygen scavenging. The prepared coating formulation can be applied using industrial coating process during the plastic film production.

In another aspect, the present disclosure relates to a method to prepare the coating formulation as defined herein, comprising the steps of a) mixing an inorganic oxygen scavenger, the surfactant, the activator, the hydrophilic agent, the additive, and b) mixing the mixture from step a) with a polymeric matrix or monomers of said polymeric matrix.

The present disclosure relates to an article comprising an inorganic oxygen scavenger, a surfactant, an activator, a hydrophilic agent, and optionally an additive dispersed within a polymeric matrix

In another aspect, the present disclosure relates to an article comprising the coating formulation as defined herein, wherein the inorganic oxygen scavenger, the surfactant, the activator, the hydrophilic agent, and the additive dispersed within a polymeric matrix.

Advantageously, a good dispersion (homogeneity) of the inorganic oxygen scavenger can be achieved without agglomeration and result in a transparent article. The article may be a film or a coating.

The present disclosure relates to a method of forming an article, comprising the step of curing a coating formulation comprising an inorganic oxygen scavenger, a surfactant, an activator, a hydrophilic agent, optionally an additive, and a polymeric matrix or monomers of said polymeric matrix.

In another aspect, the present disclosure relates to a method of forming the article as defined herein, comprising the step of curing a coating formulation comprising an inorganic oxygen scavenger, a surfactant, an activator, a hydrophilic agent, an additive, and a polymeric matrix or monomers of said polymeric matrix.

Definitions

The following words and terms used herein shall have the meaning indicated:

The term ‘biomass material’ is to be interpreted broadly to include biological material derived from living, or living organisms. This is often used to mean plant based material but can equally apply to both animal and vegetable derived material when biomass is used for energy. Herein, biomass is carbon based and is composed of a mixture of organic molecules containing hydrogen, usually including atoms of oxygen, often nitrogen, and also small quantities of other atoms, including alkali, alkaline earth and heavy metals.

Claims

1. A coating formulation comprising:
   a) an inorganic oxygen scavenger;
   b) a surfactant comprising natural clay, synthetic clay or modified clay;
   c) an activator;
   d) a hydrophilic agent selected from a polymer comprising monomers selected from an alkylene oxide, a carboxylic acid and combinations thereof;
   e) an additive being ascorbic acid; and
   f) a polymeric matrix.

2. The coating formulation of claim 1, wherein the inorganic oxygen scavenger is a composite of an inorganic metal material and a carbon material.

3. The coating formulation of claim 2, wherein the carbon material has a porous structure with a pore size in the range of 10 nm to 700 nm.

4. The coating formulation of claim 2 or 3, wherein the inorganic metal material is iron.

5. The coating formulation of any one of claims 2 to 4, wherein the inorganic metal/carbon composite comprises a plurality of the inorganic metal in particulate form disposed within or thereon the carbon material.

6. The coating formulation of claim 5, wherein the inorganic metal material has a particle size of less than 500 nm.

7. The coating formulation of any one of the preceding claims, wherein the amount of inorganic oxygen scavenger in the coating formulation is in the range 1 wt% to 20 wt%.

8. The coating formulation of any one of the preceding claims, wherein the surfactant is solid.

9. The coating formulation of any one of the preceding claims, wherein the amount of surfactant in the coating formulation is in the range of 0.5 wt% to 10 wt%.

10. The coating formulation of any one of the preceding claims, wherein the activator is a halide salt or an acidifying agent.

11. The coating formulation of any one of the preceding claims, wherein the amount of the hydrophilic agent in the coating formulation is in the range of 0.5 wt% to 10 wt%.

12. The coating formulation of any one of the preceding claims, wherein the amount of the additive in the coating formulation is in the range of 0 wt% to 2.5 wt%.

13. The coating formulation of any one of the preceding claims, wherein the polymeric matrix is selected from a polyurethane, a polyacrylate, a poly(meth)acrylate, a polyepoxide (or epoxy) or an ethylene vinyl alcohol copolymer (EVOH).

14. A method to prepare the coating formulation of any one of claims 1 to 13, comprising the steps of a) mixing the inorganic oxygen scavenger, the surfactant, the activator, the hydrophilic agent, the additive; and b) mixing the mixture from step a) with a polymeric matrix or monomers of said polymeric matrix.

15. The method of claim 14, further comprising a degassing step.

16. The method of claim 14 or 15, further comprising a crosslinking step wherein the polymeric matrix is formed by a plurality of monomers capable of forming the polymeric matrix with the addition of a polymerization crosslinker.

17. An article comprising the coating formulation of any one of claims 1 to 13, wherein the inorganic oxygen scavenger, the surfactant, the activator, the hydrophilic agent, and the additive are dispersed within the polymeric matrix.

18. The article of claim 17, which is a film.

19. The article of claim 17 or 18, wherein the transmittance of the article is more than 70%.

20. The article of any one of claims 17 to 19, which has an oxygen scavenging performance in the range of 7 cc/100 cm^2 to 9 cc/100 cm^2 without the additive.

21. The article of any one of claims 17 to 19, which has an oxygen scavenging performance in the range of 12 cc/100 cm^2 to 14 cc/100 cm^2 with the additive.

22. The article of any one of claims 17 to 21, wherein the thickness of the article is in the range of 20 μm to 40 μm.

23. A method of forming the article of any one of claims 17 to 22, comprising the step of curing a coating formulation comprising an inorganic oxygen scavenger, a surfactant, an activator, a hydrophilic agent, an additive, and a polymeric matrix or monomers of said polymeric matrix.

24. The method of claim 23, further comprising a crosslinking step wherein the polymeric matrix is formed by a plurality of monomers capable of forming the polymeric matrix with the addition of a polymerization crosslinker.

25. The method of claim 23 or 24, further comprising a step of coating the article on a polymeric substrate to form a film or a coating thereon the polymeric substrate.