structures both from corrosion and from erosion/flaking for a longer period of time.

United States Patent Application Publication Number 2012/0270968A1 (to Mao) discloses a solvent-borne anticorrosion coating composition which includes an epoxy resin, a polyamideimide, and a fluoropolymer. However, no approach to obtaining low VOC waterborne coatings is presented or suggested, and, to date, such systems are still deficient with respect to corrosion resistance and adhesion to the substrate after exposure to seawater. Therefore, it is still necessary to develop a better anti-corrosive coating composition which not only has much better anti-corrosion performance but also has better anti-erosion performance. Furthermore, in many applications it is important that the anti-corrosion coating is effective even as a single coat application, which can be applied at reduced baking temperatures, such as at a temperature of no greater than 290 °C.

Summary ~~of the Invention~~

One ~~aspect~~ embodiment of the invention disclosed herein provides waterborne anticorrosion coating compositions.

Another ~~aspect~~ embodiment ~~of the invention~~ disclosed herein provides anticorrosion films made from the aforementioned waterborne anticorrosion coating compositions, which films combine good anti-corrosion performance with excellent lubricity.

Another ~~aspect~~ embodiment ~~of the invention~~ disclosed herein provides a process for providing a corrosion-resistant coating on one or more corrodible metal surface.

Another ~~aspect~~ embodiment~~of the invention~~ disclosed herein provides anticorrosive articles protected by the aforementioned anticorrosion films.

One aspect~~The invention~~ provides a process for providing a corrosion-resistant coating on one or more corrodible metal surface, comprising:

i) forming a layer of a waterborne coating composition on said surface, said composition comprising phenoxy resin, crosslinking agent for the resin, fluoropolymer, and a liquid carrier medium;

ii) drying the layer; and

iii) heating the layer to a temperature that causes a crosslinking reaction between the phenoxy resin and the crosslinking agent, wherein the heating step is performed at no greater than 290°C, to obtain as a result thereof the corrosion-resistant coating on said metal surface; wherein the phenoxy resins are polyhydroxyether polymers having a number average molecular weight, Mn, greater than 15,000, and having terminal alpha-glycol groups; and wherein the term phenoxy resin includes modified phenoxy resins.

Preferably, the corrosion-resistant coating is a lubricious corrosion-resistant coating.

In an embodiment, the phenoxy resin has a weight average molecular weight, Mw, of at least 15,000. In another embodiment, the phenoxy resin has a weight average molecular weight, Mw, of at least 45,000.

In an embodiment, the fluoropolymer has a melting point of greater than 200°C. In another embodiment, the fluoropolymer has a melting point of greater than 300°C.

In an embodiment, the fluoropolymer has a number average molecular weight, Mn, in the range of from 20,000 to 1,110,000.

In an embodiment, the fluoropolymer has a number average molecular weight, Mn, in the range of from 20,000 to 120,000.

In an embodiment, the fluoropolymer is one of: polytetrafluoroethylene, tetrafluoroethylene-hexafluoropropylene copolymer, tetrafluoroethylene-perfluoroalkylvinylether copolymer, ethylene-tetrafluoroethylene copolymer, polyvinyl fluoride, polyvinylidene fluoride, polyhexafluoropropylene, ethylene-hexafluoropropylene copolymer, ethylene-vinyl fluoride copolymer, or

any combination thereof.

In an embodiment, the crosslinking agent is a phenolic resin, an amino resin, a multifunctional melamine, an anhydride, dihydrazide, dicyandiamide, isocyanate or blocked isocyanate, or combination

CLAIMS

What is claimed is:

1. Process for providing a corrosion-resistant coating on one or more corrodible metal surface, comprising:

i) forming a layer of a waterborne coating composition on said surface, said composition comprising phenoxy resin, crosslinking agent for said resin, fluoropolymer, and a liquid carrier medium;

ii) drying said layer; and

iii) heating said layer to a temperature that causes a crosslinking reaction between said phenoxy resin and said crosslinking agent, wherein the heating step is performed at no greater than 290°C, to obtain as a result thereof said corrosion-resistant coating on said metal surface;

wherein the phenoxy resins are polyhydroxyether polymers having a number average molecular weight, Mn, greater than 15,000, and having terminal alpha-glycol groups; and wherein the term phenoxy resin includes modified phenoxy resins.

~~2. The process of claim 1 wherein the phenoxy resin has a weight average molecular weight, Mw, of at least 15,000.~~

32. The process of claim 1 wherein the fluoropolymer has a melting point of greater than 200°C.

43. The process of claim 1 wherein the fluoropolymer has a number average molecular weight, Mn, in the range of from 20,000 to 1,110,000.

54. The process of claim 1, wherein the fluoropolymer is one of: polytetrafluoroethylene, tetrafluoroethylene-hexafluoropropylene copolymer, tetrafluoroethylene-perfluoroalkylvinylether copolymer, ethylene-tetrafluoroethylene copolymer, polyvinyl fluoride, polyvinylidene fluoride, polyhexafluoropropylene, ethylene-hexafluoropropylene copolymer, ethylene-vinyl fluoride copolymer, or any combination thereof.

65. The process of claim 1 wherein the crosslinking agent is a phenolic resin, an amino resin, a multifunctional melamine, an anhydride, dihydrazide, dicyandiamide, isocyanate or blocked isocyanate, or combination thereof.

76. The process of claim 1 wherein water comprises at least 70 wt% of said liquid carrier medium, based on the total weight of said liquid carrier medium.

87. The process of claim 1 wherein the phenoxy resin polymer is present in the waterborne coating composition in an amount of 30-65% by weight of solids based on the total weight of solids of all components in the coating composition, and the fluoropolymer is present in an amount of 10-35% by weight of solids based on the total weight of solids of all components in the coating composition.

98. The process of claim 1 wherein said metal surface comprises at least two metal surfaces fastened together, said metal surfaces each having said coating thereon, the lubricity of each said coating enabling said metal surfaces to be separated from one another when unfastened.

109. The process of claim 1 wherein the heating step is performed at a temperature below the melting point of the fluoropolymer.

1110. The process of claim 1 additionally comprising step iv) exposing the coating on said corrodible metal surface to a salt water environment.

1211. The process of claim 1 wherein the coating is a marine coating on one or more corrodible metal surface and the coating provides salt spray resistance, having less than 10% surface rust, of at least 1,000 hours on untreated steel and at least 2,500 hours on phosphated steel when the

thickness of the ~~film~~ coating is 25±5 micrometer in accordance with the ASTM B-117 testing condition.

~~13~~12. An article having a corrodible metal surface provided with a corrosion-resistant coating on said corrodible metal surface by the process of claim 1.

~~14~~13. A fastener system comprising metal components having corrodible metal surfaces and interposing screw threads, said corrodible metal surfaces provided with a lubricious, corrosion-resistant coating on the corrodible metal surfaces by the process of claim 1.

~~15~~14. An anticorrosion film consisting essentially of, as a weight percent of solids based on the total weight of solids:

(a) 30-65% by weight of one or more phenoxy resin;

(b) one or more crosslinking agent for said phenoxy resin;

(c) 10-35% by weight of one or more fluoropolymer, and

(d) one or more pigment.