According to the present disclosure there is provided a composition comprising a carrier medium, a first corrosion inhibitor in which the first corrosion inhibitor comprises at least one of an ion exchanged pigment, a silica, a calcium exchanged silica, an oxyaminophosphate salt of magnesium, and / or a mixture of an organic amine, a phosphoric acid and/or an inorganic phosphate and a metal oxide and/or a metal hydroxide, and a second corrosion inhibitor having a barrier mechanism in which the second corrosion inhibitor comprises one or more 2D material platelets in which the 2D material platelets comprise: nanoplates of one or more 2D materials and or nanoplates of one or more layered 2D materials and or graphite flakes in which the graphite flakes have one nanoscale dimension and 35 or less layers of atoms.

In an aspect, there is provided a composition comprising a carrier medium, a first corrosion inhibitor having a passivation mechanism, and a second corrosion inhibitor having a barrier mechanism in which the first corrosion inhibitor comprises at least one of an ion exchanged pigment, a silica, a calcium exchanged silica, an oxyaminophosphate salt of magnesium, and / or a mixture of an organic amine, a phosphoric acid and/or an inorganic phosphate and a metal oxide and/or a metal hydroxide, and the second corrosion inhibitor comprises one or more 2D material platelets in which the 2D material platelets comprise: nanoplates of one or more 2D materials and or nanoplates of one or more layered 2D materials and or graphite flakes in which the graphite flakes have one nanoscale dimension and 35 or less layers of atoms, wherein the second corrosion inhibitor has a D50 particle size of less than 45 μm, less than 30 μm, or less than 15 μm.

In another aspect, there is provided a coating comprising a composition as defined above.

In another aspect, there is provided a method of manufacture of a composition as defined above in which the manufacture comprises a grind stage and a let down stage, and the 2D material platelets are added at the grind stage, at the let down stage, or as a stir in additive after the let down stage.

2D materials (sometimes referred to as single layer materials) are crystalline materials consisting of a single layer of atoms. Layered 2D materials consist of layers of 2D materials weakly stacked or bound to form three dimensional structures. Nanoplates of 2D materials and layered 2D materials have thicknesses within the nanoscale or smaller and their other two dimensions are generally at scales larger than the nanoscale.

2D materials used in the composition of the present invention may be graphene (C), hexagonal boron nitride (hBN), molybdenum disulphide (MoS_2), tungsten diselenide (WSe_2), silicene (Si), germanene (Ge), Graphyne (C), borophene (B), phosphorene (P), or a 2D in-plane heterostructure of two or more of the aforesaid materials.

Layered 2D materials may be layers of graphene (C), hexagonal boron nitride (hBN), molybdenum disulphide (MoS_2), tungsten diselenide (WSe_2), silicene (Si), germanene (Ge), Graphyne (C), borophene (B), phosphorene (P), or a 2D vertical heterostructure of two or more of the aforesaid materials.

The preferred 2D material is graphene.

Preferred graphenes are graphene nanoplates, bilayer graphene nanoplates, trilayer graphene nanoplates, few-layer graphene nanoplates, and graphene nanoplates of 6 to 10 layers of carbon atoms. Graphene nanoplates typically have

CLAIMS

1. A composition comprising a carrier medium, a first corrosion inhibitor having a passivation mechanism, and a second corrosion inhibitor having a barrier mechanism in which the first corrosion inhibitor comprises at least one of an ion exchanged pigment, a silica, a calcium exchanged silica, an oxyaminophosphate salt of magnesium, and / or a mixture of an organic amine, a phosphoric acid and/or an inorganic phosphate and a metal oxide and/or a metal hydroxide, and the second corrosion inhibitor comprises one or more 2D material platelets in which the 2D material platelets comprise: nanoplates of one or more 2D materials and or nanoplates of one or more layered 2D materials and or graphite flakes in which the graphite flakes have one nanoscale dimension and 35 or less layers of atoms, wherein the second corrosion inhibitor has a D50 particle size of less than 45 µm, less than 30 µm, or less than 15 µm.

2. A composition according to claim 1 in which the 2D materials are one or more of graphene (C), hexagonal boron nitride (hBN), molybdenum disulphide (MoS2), tungsten diselenide (WSe2), silicene (Si), germanene (Ge), Graphyne (C), borophene (B), phosphorene (P), or a 2D in-plane heterostructure of two or more of the aforesaid materials.

3. A composition according to claim 1 or 2 in which the layered 2D materials may be layers of graphene (C), hexagonal boron nitride (hBN), molybdenum disulphide (MoS2), tungsten diselenide (WSe2), silicene (Si), germanene (Ge), Graphyne (C), borophene (B), phosphorene (P), or a 2D vertical heterostructure of two or more of the aforesaid materials.

4. A composition according to any of claims 1 to 3 in which the 2D material platelets have an electrical conductivity of around or less than 2.0×10^{-5} S/m at 20°C.

5. A composition according to any of claims 1 to 4 in which the first corrosion inhibitor comprises one or more of zinc chromate, zinc molybdate, zinc tungstate, zinc vanadate, zinc phosphite, zinc polyphosphate, zinc borate, zinc metaborate, magnesium chromate, magnesium molybdate, magnesium tungstate, magnesium

vanadate, magnesium phosphate, magnesium phosphite, magnesium polyphosphate, magnesium borate, magnesium metaborate, calcium chromate, calcium molybdate, calcium tungstate, calcium vanadate, calcium phosphate, calcium phosphite, calcium polyphosphate, calcium borate, calcium metaborate, strontium chromate, strontium molybdate, strontium tungstate, strontium vanadate, strontium phosphate, strontium phosphite, strontium polyphosphate, borate, strontium metaborate, barium chromate, barium molybdate, barium tungstate, barium vanadate, barium phosphate, barium phosphite, barium polyphosphate, barium borate, barium metaborate, aluminium chromate, aluminium molybdate, aluminium tungstate, aluminium vanadate, aluminium phosphite, aluminium borate, and / or aluminium metaborate.

6. A composition according to any of claims 1 to 5 in which the second corrosion inhibitor is present in the range of 0.05 wt% to 1.0 wt%, 0.05 wt% to 0.8 wt%, 0.05 wt% to 0.6 wt%, or 0.1 wt% to 0.5 wt%, 0.1 wt% or 0.5 wt%.

7. A composition according to any of claims 1 to 6 in which the first corrosion inhibitor Is present in the range of 1 wt% to 15 wt%, 2 wt% to 10 wt%, 4 wt% to 8 wt%, 4 wt% or 8 wt%.

8. A composition according to any of claims 1 to 7 in which the first corrosion inhibitor is comprised of a calcium exchanged silica, and the second corrosion inhibitor is or is comprised of graphite flakes having one nanoscale dimension and 25 to 35 layers of carbon atoms.

9. A composition according to any of claims 1 to 8 in which the carrier medium is selected from crosslinkable resins, non-crosslinkable resins, thermosetting acrylics, aminoplasts, urethanes, carbamates, polyesters, alkyds epoxies, silicones, polyureas, silicates, polydimethyl siloxanes, vinyl esters, unsaturated polyesters and mixtures and combinations thereof.

10. A coating comprising a composition according to any of claims 1 to 9.

11. A coating according to claim 10, wherein the coating has a dry film thickness of from 60 µm to 75 µm.

12. A coating according to claims 10 or 11, wherein the coating comprises multiple layers of 2D material platelets providing a labyrinthine path for the penetration of water, any dissolved oxygen it carries, and any aggressive ions such as Cl^- or H^+.

13. A method of manufacture of a composition according to any of claims 1 to 9 in which the manufacture comprises a grind stage and a let down stage, and the 2D material platelets are added at the grind stage, at the let down stage, or as a stir in additive after the let down stage.

14. A method of manufacture of a composition according to claim 13 in which the 2D material platelets are added at the let down stage

15. A method of manufacture of a composition according to claims 13 or 14 in which the grind stage comprises mixing the carrier medium and the first corrosion inhibitor.