Single and multilayer 2D-coatings for corrosion protection

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Abstract

Graphene's [1,2] chemical stability and impermeability makes it a promising membrane for protection of various forms of corrosion [3]. However, recent investigations suggested that single layer graphene cannot be used as an anti-corrosion coating in the long run, due to galvanic corrosion phenomena arising when oxygen or water penetrate through graphene cracks or domain boundaries [4]. Here, we consider two approaches to overcome this issue; a multilayered (ML) graphene/graphite film or an insulating 2D material. A thicker graphene coating increases the diffusion path and thus limits the corrosion rate. This approach is shown to be effective in very aggressive industrial testing with real, rough samples. When it comes to thinner coatings, we choose to use hexagonal Boron Nitride, the 2D counterpart to graphene. It offers an alternative to graphene with comparable physical properties in terms of strength, stability and permeability, and which due to the sizeable bandgap is highly insulating, and thus cannot give rise to galvanic corrosion [5,6,7]. In this work we compare the two approaches in terms of not only galvanic corrosion, but also scalability, tendency of delamination (with and without mechanical stress), temperature and chemical environment.

References

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Figures