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Graphene Coating and Alloy Nanocrystallinity: Novel Nano Approaches for Remarkable Corrosion Resistance

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This presentation will cover two recent nano approaches (*viz.*, Graphene Coating and Nanocrystalline Alloy Structure) for mitigation of corrosion/oxidation of metals and alloys.

A monolayer or a few atomic layer thick graphene coatings on metals have been shown to improve their corrosion resistance by up to two orders of magnitude. However, there are considerable variability in the literature on the degree of improvement (for example, improvement in aqueous corrosion resistance of copper due to graphene coating is reported to vary from insignificant to two orders of magnitude). While resons for this variability will be discussed, this presentation will also discuss the challenges in the possible application of such disruptive approach to corrosion resistance of most common engineering alloys, i.e., steels.

Author hypothesised that a nanocrystalline structure can impart extraordinary oxidation resistance, and subeseuqnetly validated this hypothesis. A thorough experiematl work established that a Fe-Cr nanocrystalline alloy with only 10wt% Cr can provide as much oxidation resistance as a Fe-20Cr alloy, suggesting possibility of Fe-Cr alloys with the necessary oxidation/corrosion resistance at much lower Cr contents. A thorough surface/subsurface characterization of oxidized alloys, using secondary ion mass spectrometry has provided a sound mechanistic understanding of the remarkable improvement in oxidation as result of nanocrystalline structure.