Graphene-Based Paints and Coatings for Enhanced Durability and Corrosion Resistance: An Application Perspective

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Abstract

Graphene and its derivative nanomaterials have attracted significant attention for their ability to enhance the performance of paints and coatings, particularly in applications demanding high durability and corrosion resistance [1]. Owing to their two-dimensional structure, high aspect ratio, and exceptional barrier properties, graphene-based materials effectively hinder the ingress of corrosive species by creating tortuous diffusion pathways within coating matrices [2]. From an application perspective, the incorporation of graphene into paint and coating systems offers notable improvements in mechanical robustness, adhesion, wear resistance, and environmental stability, making highly relevant for infrastructure, transportation, industrial equipment, and energy related applications [3]. Graphene enabled coatings can extend service life and reduce maintenance frequency, thereby contributing to lower lifecycle costs and improved sustainability [4]. Beyond corrosion protection, graphene based paints and coatings enable multifunctional characteristics such as electrical conductivity, anti-static behaviour, and thermal management, without relying on heavy metal-based or environmentally hazardous additives [5]. Current research trends emphasize the importance of scalable dispersion strategies and compatibility with conventional coating formulations to facilitate industrial adoption [6]. The role of graphene based paints and coatings in delivering durable, corrosion-resistant, and sustainable surface protection solutions is highlighted, underscoring their potential impact on long term societal and industrial needs.

References

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Figure

Figure 1: Schematic representation showing the protective mechanism of graphene-based coatings