2D materials for monitoring and protection of Cultural Heritage

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All materials used in art are prone to environmental degradation. Fading, yellowing, and discoloration are the most common degradation effects resulting from exposure to UV and visible light, and oxidizing agents. These effects of aging mechanisms lead to severe and irreversible deterioration of the legibility of works of art, which are the priceless Culture Heritage. Solvents and varnishes that have long been used to protect works of art, too often prove to be destructive solutions. A range of innovative solutions to the problem of the degradation of works of art due to natural wear and tear comes from Graphene Related Materials (GRMs). Graphene and other two-dimensional (2D) materials (hBN, WS_2, MoS_2) can be used as fillers or additives to sustainable and safe multifunctional passive coatings in order to enhance their mechanical, barrier, UV-shielding and anticorrosion properties. The synthesis and the exfoliation of GRMs is obtained through eco-friendly routes [1]. Moreover, graphene-based materials and other 2D materials has been used to evaluate their sensing properties in the monitoring of relative humidity, temperature, or gas pollutants in museum environments. These materials have been studied thoroughly for their sensing application. Among others, graphene oxide (GO) is a well-known graphene derivative with many applications, including relative humidity monitoring and gas detection [2, 3]. Green GO is producing from natural graphite via a green process in water dispersions. In addition, other 2D materials are fabricated through shear exfoliation in water-based dispersions. Furthermore, the preparation of graphene-based aerogels based on graphene oxide or hybrid aerogels with graphene oxide and other two-dimensional materials (BN, MoS_2, WS_2). These samples were examined as adsorbent materials for harmful gaseous pollutants such as formaldehyde, acetic acid, hydrochloric acid, ammonia, etc. that are usually present in museum sites.

References

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[2] Matsalis, S., et al., Fabrication and performance of capacitive humidity and strain sensors that incorporate 3D-printed nanocomposite electrodes. Sensors International, 2023: p. 100272.
[3] Paterakis, G., et al., Highly Sensitive and Ultra-Responsive Humidity Sensors Based on Graphene Oxide Active Layers and High Surface Area Laser-Induced Graphene Electrodes. Nanomaterials, 2022. 12(15): p. 2684.

Figures

Figure 1: Graphene veils for the protection of artworks