Advanced Materials for Environmental Remediation: A Focus on Polymer-Based Nanocomposites and Hybrids

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In recent years, pollutant levels in the environment have increased causing a slew of environmental issues such as global warming, soil and water contamination, and air pollution. Many strategies for mitigating the effects of these contaminants have been proposed, some of them revolving around the developed of novel advanced materials [1-2]. Nanotechnology-based materials, in particular, have shown great promise due to their high surface area-to-volume ratio and, as a result, high reactivity [2]. My PhD project fits in this frame, as its goal is to look at the possibilities of advanced nanocomposites and hybrids materials for environmental remediation. The project will be focused on three classes of materials: (i) biopolymers (such as chitosan, alginate, and cellulose), (ii) carbonaceous nanoparticles (such as graphene, graphene oxide and reduced graphene) and (iii) inorganic nanoparticles (such as transition metal oxide NPs). In particular, advanced materials for adsorption will be designed and developed to remove contaminants from either water or air. The effectiveness of the novel materials will be assessed through a wide experimental campaign, aimed at identify the most relevant structure-property relationships. In addition, simulation studies will also be carried out to get an insight into the mechanisms by which the developed polymer-based nanocomposites and hybrids are able to adsorb different classes of contaminants. The interaction of these materials with contaminants will be studied, and the resulting data will be used to improve their effectiveness in environmental remediation. The PhD project will also look into the scalability and cost-effectiveness of the proposed technologies, as well as their potential for practical application in real-world environmental remediation settings.

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