Gels for environmental remediation: from aerogels to nanosponges

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Since the industrial revolution, several industrial processes have emitted biodegradable and non-biodegradable organic and inorganic pollutants into air, soil, and water. Some harmful wastes have long resident times and remain in the environment for decades, producing imbalances in specific ecosystems. Anthropogenic pollution includes: municipal wastewater, which carries detergents, organic matter, inorganic compounds present in everyday personal care products, and urban runoff that contains contaminants originating from tires and engines; wastewater from agriculture and livestock activities, which includes pesticides, fertilizers, antibiotics, and other synthetic products; and industrial wastewaters, which varies depending on the origin: from hydrocarbons (oil refineries) to dyes (textile industry)passing by metal ions (surface treatment industries and mining).

Several physical, chemical, and biological treatment methods have been studied and applied for the removal/degradation of organic/inorganic compounds from water and soil. However, the large majority have significant drawbacks. In the last decades, Sorption processes and materials have wakened great attention being straightforward in application and often reusable, showing good efficiency and advantageous cost effectiveness.

In the last decade we have been developed research on the development of materials for sorption of a large variety of pollutants: including hydrocarbons, dyes, metal ions, antibiotics and pesticides. Different gel architectures and synthetic routes can be used to ensure specificity in the adsorption of different pollutants. Polysaccharides (e.g., chitosan), oligosaccharides (cyclodextrins, see Figure 1) and silica allow the synthesis of highly versatile materials for sorption of different pollutants. Additionally, the synthesis of new porous organic polymers with dual function (pollutant adsorption and catalysis) will also be presented and discussed.

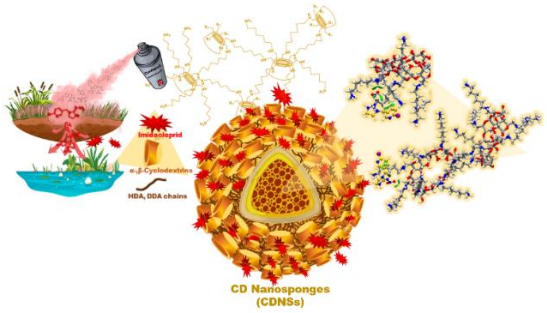

Figure 1. Schematic representation of adsorption of pesticides by cyclodextrin nanosponges.