Multifunctional bioinspired catechol-based nanoparticles

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Abstract

Catechols are found in nature taking part in a remarkably broad scope of biochemical processes and functions. Though not exclusively, such versatility may be traced back to several properties uniquely found together in the o-dihydroxyaryl chemical function; namely, its ability to establish reversible equilibria at moderate redox potentials and pHs and to irreversibly cross-link through complex oxidation mechanisms; its excellent chelating properties, greatly exemplified by, but by no means exclusive, to the binding of Fe3+; and the diverse modes of interaction of the vicinal hydroxyl groups with all kinds of surfaces of remarkably different chemical and physical nature. Thanks to this diversity, catechols can be found either as simple molecular systems, forming part of supramolacular structures, coordinated to different metal ions or as macromolecules mostly arising from polymerization mechanisms through covalent bonds. Such versatility has allowed catechols to participate in several natural processes and functions that range from the adhesive properties of marine organisms to the storage of some transition metal ions.

According to such astonishing range of functionalities, catechol-based systems have been subject in recent years to intense research, aimed at mimicking these natural systems in order to develop new functional materials and coatings. With this aim in our group we have fabricated different nanostructures ranging from nanoparticles or nanocapsules to vesicles with applications on drug delivery systems. The same materials can be used to properly functionalize bionterfaces independently of the nature of the substrate. These results will be summarized here