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CHEMICAL MODIFICATIONS OF HALLOYSITE NANOTUBES FOR THE DEVELOPMENT OF SMART NANOMATERIALS

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Halloysite nanoclays (HNTs) are promising nanomaterials because of their versatile properties, such as hollow tubular morphology and tunable surface chemistry. HNTs are biocompatible, no toxic and abundantly available at low cost. Due to these characteristics HNTs are suitable for development of hybrid sustainable materials, which are perspective for wastewater remediation, green packaging and drug delivery. HNTs are quite polydisperse in size with a length of ca. 1 μm, while the external diameter and the lumen range between 50-80 nm and 10-15 nm, respectively. Chemically, halloysite is composed of gibbsite octahedral sheet (Al-OH) groups on the inner surface and siloxane (Si−O−Si) groups on the external surface. This different chemistry allows the selective modification of HNTs surfaces. We performed several chemical functionalization of HNTs materials to confer properties valuable in specific applications.

The HNTs inner lumen was modified to generate an hydrophobic microenvironment for the solubilization of compounds sparingly soluble in water (aromatic and aliphatic oils). Oppositely, the outer surface hydrophobization was employed to create reverse inorganic micelles to be used as dispersant for hydrophilic compounds (such as $CuSO_4 \cdot 5H_2O$) in a confined environment within an organic solvent.

Grafting chemically modified cyclodextrin units onto the nanotube surface endowed to obtain a singular nanoparticle with double cavity (HNTs and cyclodextrin lumen). The obtained materials were characterized to investigate the structure and colloidal stability in aqueous dispersions. The grafted cyclodextrins were modified with thiosaccharide

pendants, to mimic the binding of sugars to proteins and the glyco-cluster effect for cellular recognition events. Drug-loading and delivery abilities were tested by using curcumin, a common naturally occurring anticancer agent.