Sustainable Nanomaterials and Supramolecular Systems for Art Conservation

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By integrating chemical synthesis, advanced characterization, and understanding of fundamental mechanisms, ISOF develops molecular systems and functional materials and investigates their structural, optical, electronic, and biological properties, contributing to the understanding of the phenomena underlying their performance and to the identification of possible future applications. Among these, ISOF has recently engaged in the CNR CHrosslab initiative to explore innovative, sustainable, and non-invasive material solutions for art preservation, contributing to the development of alternatives to traditional, aggressive restoration methodologies.

Graphene-related materials, cyclodextrin-based supramolecular systems, functional polymers, and π-conjugated photoactive molecules represent versatile and chemically tunable platforms whose properties can be rationally modulated through molecular design and chemical functionalization By introducing molecular-recognition, ionic, bioinspired, or photoactive functionalities, surface reactivity, molecular recognition, transport phenomena, and optical response can be selectively tuned to address different conservation challenges. In particular, cyclodextrins offer a highly versatile supramolecular framework whose host–guest properties and chemical functionality can be tuned to modulate affinity, solubility, and interactions with hydrophobic molecular species.

Depending on the selected functional architecture, these materials may contribute to the controlled uptake and release of solvents or active agents for localized treatment, to the development of predominantly aqueous cleaning and restoration protocols with reduced use of organic solvents, and to protective strategies aimed at improving the stability of historical and contemporary pigments and colorants against atmospheric and UV-induced degradation. Through this multidisciplinary approach, our institute bridges fundamental organic, supramolecular, and materials chemistry with green conservation science, supporting the development of more sustainable, targeted, and durable solutions for cultural heritage preservation.

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From molecules and materials design to real-world applications