Advanced Materials for Sustainable Water Treatment: Integrating Microalgae Biomass with Inorganic Nanomaterials

Magda BLOSI – *CNR-ISSMC*

The uncontrolled release of pollutants into the environment because of urbanization and industrialization is a staggering problem of global concern. Unfortunately, conventional methods of wastewater treatment are sometimes not sufficient for the removal of emerging contaminants; for this reason, new advanced techniques are increasingly studied and developed with the main challenge of developing greener and cleaner approaches. In response to these criticisms, research is moving toward the development of a new class of advanced materials for the advancement of sustainable filtration technologies in a safe-by-design perspective. We present the preparation of hybrid nanomaterials obtained combining inorganic nanomaterials (NMs) with microalgae biomass to advance the nanoremediation technology.

Here, the coupling of Neochloris oleoabundans and Phaeodactylum tricornutum with TiO2 and SiO2 NPs allowed us to explore a new challenging frontier in the bionano material design. The activity aims at developing a multifunction bio-nano catalyst able to combine heavy metal biosorption by microalgae with the photocatalytic action provided by TiO2.

The materials underwent preparation through a colloidal process followed by a cold granulation technique, supported by an extensive physicochemical characterization (DLS, ELS, BET, SEM, FTIR, ICP, UV-VIS). The evaluation of the hybrid catalysts' performance was centered on two key aspects: their ability to absorb heavy metals, tested with copper as a probe metal, and their photocatalytic activity, assessed through the degradation of Rhodamine B dye under light irradiation. The results revealed a synergistic effect in the hybrid samples, particularly enhancing heavy metal biosorption when the microalgae biomass was supported on the inorganic nanophase paving the way to new solutions for the water treatment field.