

Development and characterization of nanocatalysts for the photoelectrochemical biomass valorization coupled with hydrogenation reactions

Supervisor: Paolo Fornasiero (UniTS)

Co-supervisor: Michele Melchionna (UniTS)

The European Green Deal set a package of measures to aid the sustainable green transition and achieve the ambitious goal of making Europe the first climate-neutral continent by 2050. In this context, the use of photo-electrocatalysis has gained a dominant position, for a sustainable production of commodity and fine chemicals, given the large and free energy irradiated by the sun, which can be captured and used for many light-based devices. The project PESCHE-FU proposes a new tandem photoelectrocatalytic (PEC) approach where the photocatalytic conversion of biomass derivatives into added value products will be paired to a tunable electrocatalytic process towards either H₂ evolution or hydrogenation of unsaturated organic molecules. The target photooxidation products will be acetic acid and oxalic acid, while the electroreduction process will be investigated in the context of hydrogen production (HER process) or its direct use in hydrogenation of water-soluble unsaturated molecules (ECH process), namely olefins and phenols. To achieve these ambitious objectives, the project will explore the development of smart nanostructured photoanodes with selective capability to convert biomass-derived alcohols or industrial waste chemicals high-value products, as well as the development of new concepts for the assembly of smart electrocatalysts with a reversible structural change response to external stimuli, so to catalyse either H₂ evolution (HER process) or the hydrogenation (ECH process).

The PhD candidate will therefore have the opportunity to work at the very frontier of material science for catalysis, acquiring knowledge in modern synthesis of materials, advanced characterization and catalysis for sustainability.