Nanostructured Electrocatalysts for CO_2 Valorization to Added Value Products

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Greenhouse Gases emission control is one of the most challenging environmental issues to face in the 21st century. The electrocatalytic CO_2 reduction driven by renewable energy sources can be used to store both renewable electricity and CO_2 in valuable products such as syngas, organic acids (like formic acid) and/or liquid fuels (methanol or > C1 products with a higher energy density) [1]. The main challenge is to find a suitable electrocatalyst to establish this technology at industrial level. For the syngas (CO and H_2 mixtures) production, the most commonly used catalyst is based on noble metals like silver (Ag) and gold (Au) [2]. In our group, we have developed a low-cost Ag-based catalyst by dispersing Ag nanoparticles in the top of TiO_2 nanotubes (NTs) [3], showing a higher electrochemical surface area and electrons transport than bare Ag foil and Ag on TiO_2 nanoparticle. TiO_2 was used as an efficient support for metal catalysts, which enhances the stability of key CO_2.- radical intermediate formation and decreases the CO_2 electroreduction overpotential. Moreover, we are exploiting the current knowledge of the thermocatalytic CO_2 hydrogenation to develop an optimal electrocatalyst for the CO_2 electrochemical reduction. When Cu/Zn/Al-based catalysts are tested for these two processes different products are obtained at the respective optimum operative conditions (i.e. high H_2 partial pressure (P) and temperature (T) > 200oC for the thermocatalytic CO_2 reduction, while atmospheric T and P are used in the electrocatalytic one). While the thermocatalytic process induces the production of methanol and CO, the electrocatalytic one generates H_2, CO as well as other C-containing liquid products (from C_1 to C_3). We have developed low-cost nanostructures catalysts able to produce syngas with a tunable composition (depending on the applied potential) and other liquid C_2+ products through the electrochemical CO_2 reduction at ambient T,P. These results pave the way to the implementation of novel nanostructured materials towards the development of a highly sustainable and economic technology for the CO_2 conversion to the fuels of the future.

Biography:

Simelys Hernández had a PhD in Chemical Engineering from Politecnico di Torino (Polito), Italy. She is an Associate Professor of Chemical Plants and responsible of the “CO_2 reduction for a low-carbon economy team” at CREST group, DISAT - Polito. She is technical coordinator of the EU H2020 projects SunCOChem, CELBICON and RECODE focused on CO_2 capture (from atmosphere or flue-gases) and its conversion to valuable chemicals, fuels and biopolymers. She is author of >80 papers in ISI journals, including book chapters. Her H-index is 27. She is among the TOP 2% scientists in the Applied Science – Engineering field and is a repute member of editorial and reviewer boards of top journals (e.g. Nature Catalysis).

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