ZEOLITE TEMPLATE CARBON PERFORMANCES IN CATALITIC AND ADSORPTION APPLICATIONS

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Carbon-based materials synthesized in the nanochannels of powdered zeolite acting as Template (Zeolite Template Carbon ZTC) are a relatively new class of materials that are receiving a growing attention from the scientific community for their interesting properties that can be in turn tuned to obtain tuneable porosity features. Owing to their large specific surface area (up to 4000 m^2/g), nano-ordered structure, chemical stability and electric conductivity ZTC represent promising materials in different fields: from classic capacitors applications to more innovative (electro)catalytic and Carbon Capture and Storage (CCS) processes.

Providing large surfaces of the material, they can potentially guarantee high performances in all the applications based on surface interaction: storage processes with the advantage of the reversible gas adsorption phenomena and catalytic systems. This talk offers an overview about synthesis and some recent findings on those new application fields, taking into account one of the less considered aspect of ZTC: the presence of surface oxygen bonded in different ways to the carbon. Of course, these "defects" on the surface could not be avoided as it comes mostly from the synthesis/purification processes, but the content and type of carbon-oxygen bond significantly affect the surface properties. In addition, even though few examples have been published in the literature, chemical treatments can be also used to modify and tune the oxygen content, tailoring the ZTC properties to specific applications.

The talk will offer two different examples of "oxygen-modulated" ZTC applications in the general field of carbon dioxide emission reduction, either in case of Capture-and -Storage system or in the field of electrocatalytic reduction, as potential support to a high impact strategy to close the anthropogenic carbon cycle.

In the CO_2 adsorption, the high order of structural framework favourably impacts on the gas adsorption capacity. Low-pressure adsorption data revealed that two main parameters affect the performances: specific surface area and surface post-synthesis treatment governing the oxygen amount. Experimental evidences indicate that high surface area favours the CO_2 adsorption together with a high microporous fraction. In the case of surface treated ZTC, the reduction of the oxygen present on the pore surface causes a reduction of the CO_2 adsorption capacity recovered after a couple of CO_2 adsorption cycles indicating a structure stabilization, induced by CO_2, with reduction of defect groups favouring the adsorption in a complete reversible way from the third cycle on.

The study of electrocatalytic behaviour of ZTCs based electrodes in the electrocatalytic reduction of CO_2 offers a clear example of how the de-oxygenation treatment allows a significant increase of selectivity toward formate production, observing a Faradaic efficiency quadrupled in comparison with the untreated ZTCs samples.