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Amine-functionalization of silica using supercritical CO_2

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Capture and storage of CO2 is a topic of great scientific and public interest. At present, the most diffused process for CO2 capture is wet scrubbing, where CO2 is absorbed by liquid amines. However, this system is highly energy-demanding due to the solvent regeneration step; moreover, liquid amines can quickly corrode the employed equipment. As an alternative, solid adsorbents present appealing properties, since they are easier to regenerate and manipulate. In this perspective, the functionalization of mesoporous silica (which offers the advantage of a high specific surface area) with different amines has been explored by using a green solvent, supercritical CO2 (scCO2), in place of the conventional organic ones. Therefore, two amines were loaded on a SBA-15 silica through scCO2 impregnation: the most-commonly-used (3-aminopropyl)triethoxysilane (APTES) and the higher-molecular-weight, 1,6-diaminohexane (DH). The resulting materials were physico-chemically characterized and their capacity of capturing CO2 was evaluated through volumetric tests (CO2 adsorption isotherms at 25 °C) while Fourier Infrared Spectroscopy was employed to characterize in-situ the surface species formed by CO2 adsorption at room temperature. Results show that the amines were successfully loaded on the silica support. Even when these molecules are not anchored through covalent bonds to the surface (as in the case of DH), they are, nevertheless, stable at temperatures compatible with those of the thermal regeneration of the support (120 °C). Interestingly, the so-obtained adsorbents result to be particularly effective in capturing CO2 at low partial pressure.

Biography:

Marta Gallo is a biomedical engineer holding a Ph.D. in Material Science. She first worked on ceramics for bone replacement. Lately, she broadened her expertise getting involved in the development of silica-based porous systems for the adsorption or the release of molecules in the environmental and pharmaceutical sectors, respectively. Her know-how encompasses the development of these systems from their synthesis up to the evaluation of their performances. Marta Gallo carried out her Ph.D. and worked as a post-doc in France (INSA, Lyon) and in Germany (FAU University, Erlangen); now she works in Italy at Politecnico di Torino.