Rice husk derived materials for environmental applications

In the last year, the global rice consumption has exceeded 750M tons and, as consequence, more than 150M tons of rice husk (RH), *i.e.,* the hull that cover the rice grain, are produced. Despite the several ways to recycle this agricultural waste, a high portion of RH is directly burned in the fields after the rice harvest, thus leading to a series of respiratory diseases, as well as to the emissions of tons of greenhouse gases, such as CO_2. Herein, we report about a novel approach to employ the biogenic silica within RH, that represents *ca*. the 15 wt.% of RH, as a more cost-effective and environmentally friendly silicon source to prepare an improved nanostructured adsorbent material with tuned physico-chemical properties.

In detail, a nanometric mesoporous silica (coded as RH-nanoMCM) with mesopores of *ca*. 40 Å and particle size dimension of about 60 nm was prepared from the amorphous silica extracted from RH by means of a double surfactant synthetic approach, that allows to control both the formation of mesopores and the particle size growth. To the best of our knowledge, this is the first time that a double surfactant approach has been adopted to prepare a nanometric size mesoporous silica from biogenic silica extracted from rice husk.

As found by XRD diffraction, RH-nanoMCM sample is characterized by a long-range ordered 2D hexagonal structure with cylindrical pores typical of MCM-41 silicas, and by a high SSA_{BET} and pore volume of 1050 $m^2 \cdot g^{-1}$ and 1.68 $cc \cdot g^{-1}$, respectively. Nevertheless, by means of TEM analysis it was demonstrated that the obtained silica has a particle size of *ca*. 20-30 nm.

The solid was tested as sorbent for the removal of the cationic dye Rhodamine B and toluene from aqueous and gas phase, respectively, showing excellent adsorption capacity toward both pollutants.