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## Innovative carbon-based materials for solid state hydrogen storage and energy storage

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**A**lkali cluster-intercalated fullerides (ACIF) consist in crystalline nanostructures in which positively charged metal clusters are ionically bond to negatively charged  $C_{60}$  molecules, forming charge-transfer salts. These compounds have been recently investigated with renewed interest, appearing as a novel class of materials for hydrogen storage, thanks to their proved capability to uptake reversibly high amounts of hydrogen via a complex chemisorption mechanism. In this presentation, after a short summary on the hydrogen storage topic, the synthesis, the structural investigation and the hydrogen storage properties of Li, Na and mixed Li-Na clusters intercalated fullerides belonging to the families  $Na_xLi_{12-x}C_{60}$  ( $0 \leq x \leq 12$ ) and  $Na_xLi_{6-x}C_{60}$  ( $0 \leq x \leq 6$ ) will be presented. By manometric and thermal analyses it has been proved that  $C_{60}$  covalently binds up to 5.5 wt%  $H_2$  at moderate temperature and pressure, thanks to the catalytic effect of the intercalated alkali clusters. Moreover, the destabilizing effect of Na in the co-intercalated  $Na_xLi_{6-x}C_{60}$  compounds leads to an improvement of the hydrogen-sorption kinetics by about 70%, linked to a decrease in the desorption

enthalpy from 62 to 44 kJ/mol  $H_2$ . The addition of Pt and Pd nanoparticles to Li fullerides increases up to 5.9 wt%  $H_2$  the absorption performances and of about 35 % the absorption rate. The ammonia storage properties of  $Li_6C_{60}$  have also been investigated, resulting quite appealing. Being the price of  $C_{60}$  quite high for large scale practical applications, new cheaper C based materials are under examination. In particular, porous biochar from agricultural waste are giving quite interesting results as electrode materials for high-performance supercapacitors.

### Speaker Biography

Milanese Chiara is associate professor of Physical Chemistry at the Chemistry Department of the University of Pavia (Italy). Her main research interests regard the synthesis of innovative nanomaterials for solid state hydrogen storage and for energy storage, their physico-chemical characterization and the evaluation of their storage performance. In the last 5 years, her attention was mainly focused on C-based materials, in particular fullerene derivatives and biochar. She is author of 165 papers on materials science topics and she is expert of the IEA Task 40 "Energy storage and conversion based on hydrogen".

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