

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

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Abstract

Alkali cluster-intercalated fullerides (ACIF) consist in crystalline nanostructures in which positively charged metal clusters are ionically bond to negatively charged C₆₀ 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}C₆₀ ($0 \leq x \leq 12$) and Na_xLi_{6-x}C₆₀ ($0 \leq x \leq 6$) will be presented. By manometric and thermal analyses it has been proved that C₆₀ covalently binds up to 5.5 wt% H₂ 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}C₆₀ 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 H₂. The addition of Pt and Pd nanoparticles to Li fullerides increases up to 5.9 wt% H₂ the absorption performances and of about 35 % the absorption rate. The ammonia storage properties of Li₆C₆₀ have also been investigated, resulting quite appealing. Being the price of C₆₀ 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 supercapacitor.

Biography

Chiara Milanese 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. Chiara Milanese 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".

Publications

1. Metabolic effects of aerobic training and resistance training in type 2 diabetic subjects: a randomized controlled trial (the RAED2 study)
2. Anthropometry and motor fitness in children aged 6-12 years
3. Anthropometry and body composition of female handball players according to competitive level or the playing position
4. Body composition, eating disorder psychopathology, and psychological distress in anorexia nervosa: a longitudinal study
5. Ten-week whole-body vibration training improves body composition and muscle strength in obese women
6. Measured physical activity in anorexia nervosa: features and treatment outcome
7. Seasonal DXA-measured body composition changes in professional male soccer players
8. In Vivo Phenotyping of the ob/ob Mouse by Magnetic Resonance Imaging and ¹H-Magnetic Resonance Spectroscopy
9. The Eating Disorder Examination Questionnaire: reliability and validity of the Italian version

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