FULLERIDES AS A NEW PROMISING MATERIALS FOR HYDROGEN STORAGE

Magnani G. [1]***, Gaboardi M.*** [1]***, Pontiroli D.*** [1] ***, Ricco' M.*** [1] ***, Milanese C.*** [2] **, Peterson V.** [3]**.**

[1] Department of Physics and Earth Sciences, University of Parma, Parma, Italy
[2] H_2-Lab., University of Pavia, Pavia, Italy
[3] Bragg Institute, Australian Nuclear Science and Technology Organization (ANSTO), Lucas Heights, Australia

e-mail: *giacomo.magnani@fis.unipr.it*

Curved carbon based materials sheets have an enhanced capacity to store H_2 and are widely studied systems in the field of gas storage mainly for their light weight and high porosity.
Fullerene molecule presents a curved carbon plane and a well known ability to accept large degrees of charge. In fact metal ions can donate charge to the curved plane, playing a key role to optimize the H_2 binding energy and the absorption increases if the curved sheet is charged.
For these reasons metal clusters intercalated fullerides have been recently investigated with renewed interest, appearing as a novel class of materials for hydrogen storage, thanks to their
proved capability to reversibly uptake high amounts of hydrogen via a complex chemisorptions mechanism.
The synthesis, the structural investigation and the hydrogen storage properties of these materials were investigated by means of in-situ neutron diffraction to understand the structural evolution during the hydrogenation process and the mechanism of hydrogenation was unveiled by means of the Muon Spin Relaxation spectroscopy (μSR).
These materials were proved to reversibly absorb up to 5.5 wt% H_2 at moderate temperature and pressure [1] through the catalytic effect of intercalated clusters [2]. Recently, we studied the H2 absorption/desorption properties of the mixed intercalated phases $Na_xLi_{(6-x)}C_{60}$, succeeding in increase the absorption kinetics of about 67% and lowering the desorption enthalpy from 60 to 50 kJ/mol [3]. Furthermore, we also identified some strategies to further improve the absorption in this class of materials adding Ni, Pt and Pd nanoparticles to alkali metals intercalated fullerides, whose known catalytic activity towards hydrogen dissociation allows to increase up to 5.9 wt% H_2 the absorption performances [4].

References

1. P. Mauron, M. Gaboardi, A. Remhof, A. Bliersbach, D. Sheptyakov, M. Aramini, G. Vlahopoulou, F. Giglio, D. Pontiroli, M. Riccò, and A. Züttel, *Hydrogen sorption in $Li_{12}C_{60}$,* J. Phys. Chem. C (2013) 117, 22598.
2. M. Gaboardi, C. Cavallari, G. Magnani, D. Pontiroli, S. Rols, and M. Riccò, *Hydrogen storage mechanism and lithium dynamics in $Li_{12}C_{60}$ investigated by μSR,*Carbon (2015) 90, 130
3. M. Gaboardi, C. Milanese, G. Magnani, A. Girella, D. Pontiroli, M. Riccò, *Hydrogen storage investigation of NaxLi6-xC60 mixed phases*, manuscript in preparation (2015).
4. M. Aramini, C. Milanese, D. Pontiroli, M. Gaboardi, A. Girella, G. Bertoni, and M. Riccò, Int. J. Hydrogen Energy (2013) 9, 1.

Giacomo Magnani is a Ph.D.student in Materials Science and Technology in Parma University. His activity is focused on synthesis, characterization and physical study of new carbon based materials (fullerides and graphenes) for the storage of hydrogen and as costituents of innovative ionic batteries.