Synthesis and characterization of nanocrystalline LaNi$_5$ hydrogen storage materials

B. Joseph$^1$, B. Schiavo$^{2,3}$, B. R. Sekhar$^1$, G. D’Ali$^{2,3}$

$^1$Institute of Physics, P.O. Sainik School, Bhubaneswar, 7511005, India
$^2$Dipartimento di Fisica e Tecnologie Relative-DIFTER, Università di Palermo, Italy
$^3$Istituto Tecnologie Avanzate, Trapani, Italy

With the growing environmental concerns of greenhouse gas emissions from the burning of fossil fuels, it is becoming increasingly important to switch to cleaner alternative fuels such as hydrogen [1]. Inter-metallic LaNi$_5$ is one of the most widely used and studied solid-state hydrogen storage material – a pet material for the prototype systems using hydrogen fuel. However, nanostructuring effects on this systems are not yet fully explored. Recently we have carried out systematic studies regarding the effect of nanostructuring on the hydrogen sorption properties of this material [2]. Unlike some other potential hydrogen storage materials, which shows faster kinetics upon nanostructuring, the long time ball-milling of the bulk LaNi$_5$ results in the formation of an anomalous-state resistant to hydrogen absorption-desorption reactions. In this contribution, we present the preliminary differential scanning calorimetry (DSC), x-ray diffraction (XRD) and x-ray photoemission spectroscopy (XPS) data on the nanostrutured LaNi$_5$ powders. XRD and XPS results indicate the long-time ball-milled and annealed LaNi$_5$ to be of pure nanocrystalline phase. DSC results indicate a partial elimination of defects at 500°C, in a more efficient way for the short-time ball-milled powders compared to the long-time ball-milled samples. These results will be discussed in the light of the hydrogen sorption properties of the bulk and nanocrystalline LaNi$_5$ samples.
