Materials Panel Abstract & Speaker Biography

Nanoengineering carbon cathodes for Lithium Sulphur batteries

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The lithium sulphur battery (LSB) possesses high gravimetric and volumetric energy density and is, nowadays, the closest technology to fulfil energy requirements for the upcoming revolution on electric vehicles. In a LSB, the positive electrode is usually a composite of sulphur and a conductive matrix and the negative electrode is lithium metal. The average redox voltage of a LSB is 2.1 V during discharge and leads to energy densities up to 500 Wh/kg , doubling the energy contained in a Li-ion battery.

Our more recent work on the synthesis and characterization of positive electrodes for high-power LSBs will be presented. With the use of the electrospinning technique, a simple and cost-effective way to produce binder-free electrodes, we have synthesized several carbon nanofibers (CNFs) that act as a conductive matrix for the insulating polysulfide phases formed during electrochemical reduction and minimize migration of these species to the negative electrode. Figure 1a inset shows a SEM picture of sulfurized CNFs. The fibbers have 300-400 nm of diameter and show homogeneous distribution of sulphur which was incorporated into the matrix by the impregnation method. Electrochemical testing versus lithium show that sulfurized CNFs deliver high capacity with good retention, figure 1, i.e. ≥ 900 mAhg-1 at C/20 and 223 mAhg-1 at 1C. We have also investigated other approaches to increase the surface area of the CNFs and, in turn, maximize the amount of sulphur incorporated in the host matrix. Figure 1 b shows a hollow CNF that was prepared using two solutions, i.e. Poly(methyl methacrylate) (PMMA) and polyacrylonitrile (PAN), figure 1b inset. Different synthesis approaches based on the electrospinning technique will be presented and their electrochemical performance discussed. This research is funded by the HELIS project (HORIZON 2020); 666221.

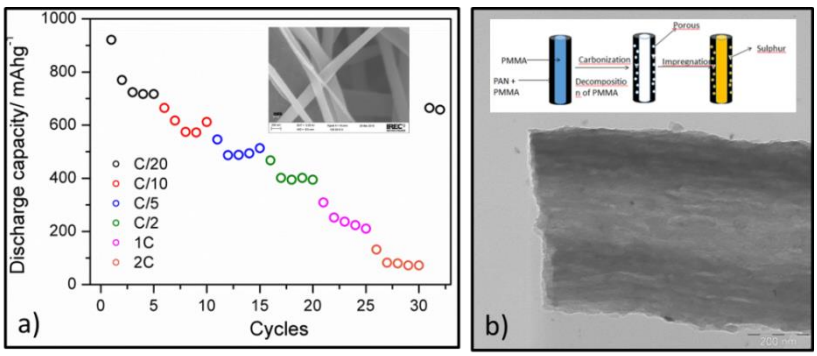

Figure 1 a) capacity retention of sulfurized CNFs versus lithium as function current rate and, inset, an SEM picture of the sulfurized CNFs prior electrochemical testing b) TEM picture of a hollow CNFs prepared using the approach described inset.

References

1. Min-Kyu Song, Yuegang Zhang and Elton J. Cairns, Nano Lett. 2013, 13, 5891-5899, Kunpeng Cai, Min-Kyu Song, Elton J. Cairns and Yuegang Zhang, Nano Lett. 2012, 12, 6474-6479
2. www.panasonic.com

Speaker Biography:

Dr. Jordi Jacas Biendicho obtained his PhD in Materials science at Sheffield University on the electrical and electrochemical characterization of olivine based electrode materials for Li-ion batteries under the supervision of Prof. Anthony R. West. His first postdoc was conducted at Stockholm University and ISIS neutron spallation source where he developed new tools to characterize secondary batteries in situ as well as design of new electrode materials and upgrading of the HRPD instrument.

Jordi currently works at IREC and is involved in two European projects i.e. INFLUENCE and HELIS, which are devoted to the understanding and improvement of Semi Solid Flow Batteries (SSFB) and Li-S batteries, respectively. He is interested on the development of new energy systems and understanding the factors that limit or promote their performance by the use of various techniques ranging from impedance spectroscopy, electrochemistry and diffraction.