New carbon materials as anodes for Li-ion secondary batteries

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Graphite and coke are well known anode materials for Li-ion secondary batteries [1]. The graphitic anode materials in commercial Li-ion batteries present a reversible capacity of 372 mAh/g, which correspond to a maximum coordination capability of 1 lithium ion for 6 carbon atoms (LiC_6) [2]. Different mesophase carbons can have more Li accommodation possibilities than graphite and capacity as high as 800 mAh/g are reported [3]. This work reports first results on new graphene materials obtained by pyrolysing hexa and tri-phenyl benzene (HPB and TPB) at different temperatures. All materials were synthesized by Prof. Klaus Muellen (Max Plank Institute for Polymer Research in Mainz, Germany). Cell electrodes were obtained by dispersing a mixture of the active material and small quantities of a binder (PVdF) in a solvent, and casting the mixture on a thin copper foil. In the laboratory type cells Li has been used as counter and reference electrode, and an organic EC-DEC as electrolyte. Cyclic voltammetry and step voltammetry experiments have been carried out in order to evaluate the reversibility and the kinetics of the intercalation processes. Ex-situ and in-situ XRD have been performed in order to detect the phase transitions during the intercalation steps. Impedance response analysis has been used to have information on charge transfer parameters. Finally galvanostatic cycling at constant current rates allowed to evaluate the specific capacity and the intercalation volume levels of the graphene electrodes. In Fig 1 a step voltammetry of the HPB sample pyrolysed at 800 °C is showed. In Fig. 2 the specific capacity values of the same sample containing small amount of electronic conductor are reported.

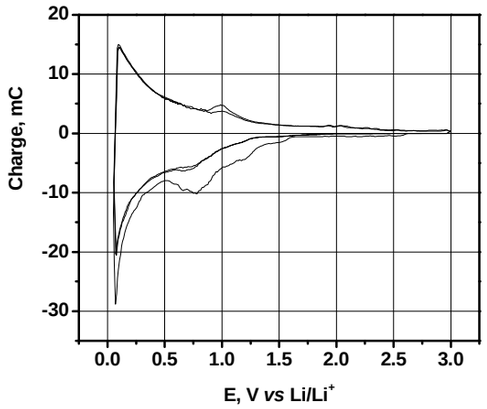

Fig. 1 – Step voltammetry of an HPB 800 °C pyrolised electrode

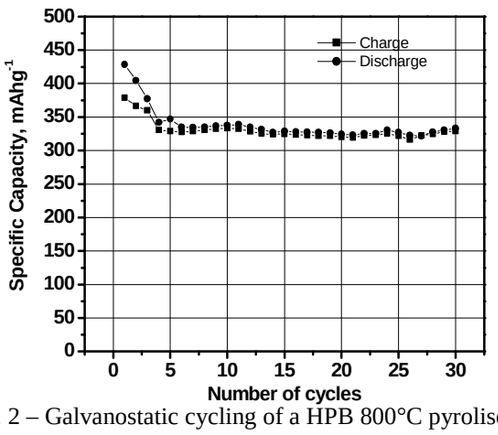

Fig. 2 – Galvanostatic cycling of a HPB 800°C pyrolised electrode containing small amount of electronic conductor in the mixture

Acknowledgments-
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[1] "Handbook of batteries" ed. by David Linden, Mc.Graw-Hill, New York (1995) Chap. 36.

[2] "Handbook of battery materials" ed. by Wiley-VCh, Weinheim (2000) Part III, Chap.5

[3] N. Takami, A Satoh, T Oshaki and M. Kanda, J.Electrochem. Soc. 145, 478 (1998).