Plasma-modified powder materials for Li-ion battery anodes processable by water-based techniques

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The **goal of PLASMANODE** was to **develop eco-friendly negative electrodes for Li-ion batteries by using water-based processing**. To that aim, all materials should (i) resist to water, (ii) be easily dispersible in the water/binder mix and (iii) keep their cycling properties once processed as electrode. The targeted materials (Si powders with micro- and nanosized particles from Ferroglobe and specific TiO_2 crystalline forms from TioTech) were coated with different materials using low-temperature plasma (by ICS). Conductive additives were modified by plasma to make them dispersible in water-based slurries. Electrodes were prepared *via* a water-based process and their electrochemical performances were assessed (ULiège, TioTech, Ferroglobe). Ageing of coated materials in humid atmosphere prior to electrode manufacturing was also investigated.

Regarding powder treatment by plasma, the project enabled to identify processing conditions for surface activation. The project also succeeded in modifying the surface properties of carbon nanotubes and carbon black: stable (> 4 months) suspensions of carbons in water were obtained, which led to homogeneous and easy to process electrodes.

Regarding TiO_2, it was surprisingly found that TioTech's materials could be processed directly (without coating) by optimized water-based techniques, with good electrochemical properties. Plasma coatings did not bring major improvements of either electrochemical performance or ageing in humid atmosphere, but further investigations are needed to study the impact on surface passivation. **For Si**, Cu/C coatings on nanosilicon led to moderate improvement of the cycling capabilities of electrodes processed in water with high amounts of Si (70%).

This project opens doors towards efficient water-based processing of battery electrode materials. The strategy could also be applied to positive electrode powders; the topic is currently investigated by ICS and ULiège through another collaborative project.

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