V_2O_5 NANORIBBONS FROM REVERSE MICELLES AND ORGANIC OXIDANTS FOR BATTERY INSERTION ELECTRODEs

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Single and mixed vanadium oxides have been extensively studied for insertion electrodes of rechargeable batteries due to its high capacity, low cost and wide availability [1]. In the last years, advances in Li-metallic anode stabilization, the continuous advances in solid-state electrolytes including those in combination with ionic liquids, and the advances in synthesis/processing routes have renewed the interest in vanadium oxides. Broad consensus exists that in order to maximize efficiencies in electrochemical properties, inorganic nanoscale materials must be used. Particularly, 1D-configurations (nanoribbons, nanoroads …) are very appealing as electronic and diffusive transports are enhanced, and they can withstand mechanical stresses during electrode cycling.

For this work, we have developed an original synthetic method based on reverse micelles for the growth at room temperature and atmospheric pressure of V_2O_5 nanoribbons [2]. Essential for the success of the method was the use of a soluble organic oxidant that acts as oxidant and co-surfactant during the synthesis, and facilitates surfactant removal with a simple washing protocol. An important feature of the synthesized V_2O_5 nanoribbons is that the red powder obtained after drying retains excellent solution-processable capabilities. Using this powder, we are able to process electrodes with three different configurations: Binder, Binder-free and Additives free (Figure 1). The electrochemical studies in Li-half cells shown that, a low rate (0.2C, 59 mA/g) the capacity of the V_2O_5 nanoribbons (ca. 200 mAh/g) was similar for the three electrode configurations. This result indicated that the nanoribbons were not altered during the different processing protocols. All the electrodes exhibited excellent rate capabilities and remarkable cycling performances [2]. Thus, the Additive free electrode retained 95% of the nominal capacity after 200 cycles at 5C charge/discharge rate.
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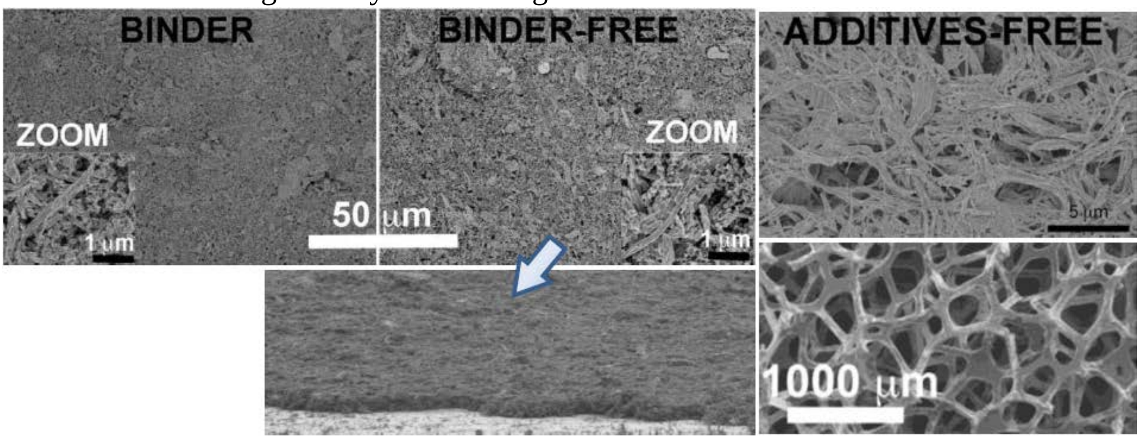

Figure 1: SEM micrographs of V_2O_5 nanoribbons electrodes manufactured following three different processing procedures

References :

[1] a) D. McNulty, D.N. Buckley, C. O'Dwyer, J. Power Sources 267 (2014) 831-873, b) J.M Amarilla, M.L. Pérez-Revenga, B. Casal, E. Ruiz-Hitky Catalysis Today 78 (2003) 571-579.
[2] P. Tartaj, J.M. Amarilla, B. Vazquez-Santos Langmuir (2015, submitted)