**Supplementary Information**

**Preparation of TiO2-(B)/SnO2 nanostructured composites and its performance as anodes for lithium ion batteries**

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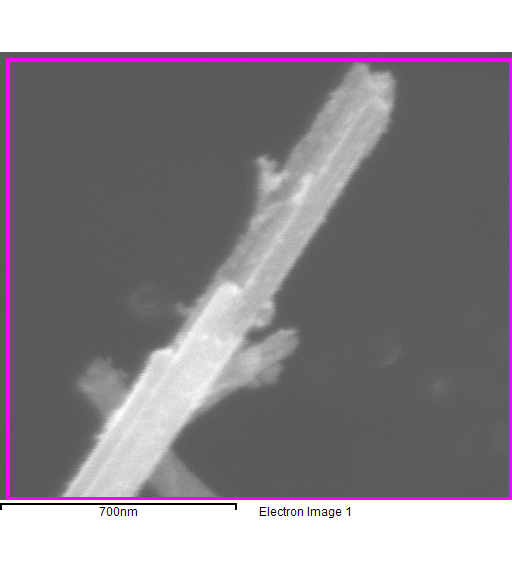
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| --- | --- |
| TiO2 SnO2 450C 50-50 200,000x_058 editada 12-40  **TiO2/SnO2 50/50** | IncaTemp26  **Oxygen (O)** |
| IncaTemp24  **Titanium (Ti)** | IncaTemp25  **Tin (Sn)** |
| |  |  |  | | --- | --- | --- | | **Element** | **% wt** | **% at** | | **O** | **17.83** | **43.08** | | **Ti** | **62.66** | **50.57** | | **Sn** | **19.51** | **6.35** |   IncaTemp59 | |

Figure SI-1. Energy dispersive X-ray spectroscopy (EDX) elemental mapping for TiO2-(B)/SnO2 50/50: a nanoribbon of TiO2-(B) in which SnO2 nanoparticles are distributed on its surface. Higher intensities of Ti (red) detected in the region of the nanoribbon while the Sn (green) is uniformly distributed along the nanoribbon.



**TiO2/SnO2 70/30**

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| --- | --- |
|  | IncaTemp25  **Oxygen (O)** |
| IncaTemp26  **Titanium (Ti)** | IncaTemp27  **Tin (Sn)** |
| |  |  |  | | --- | --- | --- | | **Element** | **% wt** | **% at** | | **O** | **54.77** | **80.60** | | **Ti** | **35.57** | **17.48** | | **Sn** | **9.66** | **1.92** |   IncaTemp23 | |

Figure SI-2. Energy dispersive X-ray spectroscopy (EDX) elemental mapping for TiO2-(B)/SnO2 70/30: a nanoribbon of TiO2-(B) in which SnO2 nanoparticles are distributed on its surface.





Figure SI-3. (a) N2 adsorption-desorption isotherms of samples: TiO2-(B)-AME, SnO2, TiO2-(B)/SnO2 50/50 and TiO2-(B)/SnO2 70/30. Solid and empty geometric figures refer to adsorption and desorption isotherms respectively. (b) The pore size distribution from BJH adsorption branch of the respectively samples.

To examine structural integrity the coin cells were disassembled, and the TiO2-(B)/SnO2 50/50 and 70/30 electrodes were taken out and immersed in ethanol to remove the electrolyte. It is important to remember that electrodes were prepared with a mixture containing 80:10:10 wt % of active material, carbon black and Teflon and pasting the mixture on a stainless steel mesh. Later the electrode was assembled and put into contact with LiPF6 (1 M) in ethylene carbonate (EC) and diethyl carbonate (DEC) used as the electrolyte.

The morphological study was performed on the non-cycled electrodes as well as on the electrodes after 50 cycles, and the results for TiO2-(B)/SnO2 50/50 and 70/30 electrodes are shown in Figures SI-4 and SI-5, respectively. It can be seen that the morphologies of the electrode composite are significantly different compared to TiO2-(B) nanoribbons with SnO2 nanoparticles comprising the active material. It is found that the non-cycled electrodes show aggregates of particles in the form of granules or flakes, whereas after cycling they present smoother edges. Whereas, the initial morphology still can be identified even after 50 cycles, micrographs of both cycled electrodes TiO2-(B)/SnO2 50/50 and 70/30 look very similar, irregular-shaped particles were found, no pulverization of the material was observed. This structure on the cycled electrode can be described as a gel-type layer formed on the electrodes which may be due to reaction of electrolyte to electrode materials. The smooth and uniform distribution of the TiO2-(B)/SnO2 50/50 after 50 cycles leads to a high electrochemical performance. In order to confirm the distribution of Ti and Sn on the nanocomposites after 50 cycles, elemental mapping by EDX were conducted. As can be seen in the Figures SI-4 and SI-5, the elemental mapping clearly indicates that the Ti and Sn were homogeneously dispersed.

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| **TiO2/SnO2 50/50** | | |
| C:\Users\Nayely\Desktop\CIMAV HOME OFFICE\PAPER\JUNIO 2020\SEM JULIO 2020\Muestras 2020.07.03\TiO2-SnO2 50-50 SIN CICLOS\20 000 X2 50 50 sin ciclos.jpg  **Non-cycled electrode** | C:\Users\Nayely\Desktop\CIMAV HOME OFFICE\PAPER\JUNIO 2020\SEM JULIO 2020\Muestras 2020.07.03\TiO2-SnO2 50-50\20 000 X2 editada.jpg  **Cycled electrode**  **Cycled electrode** | IncaTemp63  **Cycled electrode**   |  |  |  | | --- | --- | --- | | **Element** | **wt %** | **at**  **%** | | **C** | **14.10** | **24.24** | | **O** | **32.25** | **41.64** | | **F** | **21.62** | **23.51** | | **P** | **3.66** | **2.44** | | **Ti** | **12.56** | **5.44** | | **Sn** | **15.81** | **2.75** | |
| IncaTemp9IncaTemp5IncaTemp8 | | |

Figure SI-4. Morphology study of TiO2-(B)/SnO2 50/50 non-cycled electrode and after 50 cycles.

|  |  |  |
| --- | --- | --- |
| **TiO2/SnO2 70/30** | | |
| C:\Users\Nayely\Desktop\CIMAV HOME OFFICE\PAPER\JUNIO 2020\SEM JULIO 2020\Muestras 2020.07.03\TIO2-SnO2 70-30 SIN CICLOS\20 000 X-2 70-30 sin cuclos.jpgIncaTemp149   |  |  |  | | --- | --- | --- | | **Element** | **wt %** | **at**  **%** | | **C** | **34.48** | **50.26** | | **O** | **39.99** | **43.76** | | **P** | **0.93** | **0.53** | | **Ti** | **8.38** | **3.06** | | **Sn** | **16.21** | **2.39** |   **Non-cycled electrode** | C:\Users\Nayely\Desktop\CIMAV HOME OFFICE\PAPER\JUNIO 2020\SEM JULIO 2020\Muestras 2020.07.03\TiO2-SnO2 70-30\20 000 X2editada.jpg  **Cycled electrode** | **Cycled electrode** |
| **Cycled electrode**  IncaTemp29IncaTemp28IncaTemp26 | | |

Figure SI-5. Morphology study of TiO2-(B)/SnO2 70/30 non-cycled electrode and after 50 cycles.