Chemical beam deposition of TiS_2 thin films for *operando* XPS studies of Na electrochemical intercalation

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Lithium-ion batteries are the technology that enabled todays' mobile world, and are being introduced in larger scale applications such as electric vehicles and grid storage. These perspectives open the possibility of supply shortages in front of a surge of lithium demand. Larger devices also provide stronger safety requirements.
Sodium ion batteries are regarded as the most promising alternative chemistry that can satisfy a demand increase by orders of magnitude and provide additional safety.
Both Li- and Na-ion batteries are based on the intercalation reaction, however the larger Na^+ ion size restricts the choice of host materials, being layered materials the most obvious class.
TiS_2 is a layered dichalcogenide already considered in early alkali batteries [1] that recently showed excellent electrochemical properties in optimized Na-ion batteries [2].
In this paper we will present the optimization of the synthesis in ultra-high vacuum of TiS_2 thin films from metal-organic sources. The effect of precursors and their partial pressure, substrate and temperature, has been studied by XPS and mass spectroscopy.
The resulting films are composed by mainly upright platelets of 50-100 nm diameter and 5-10 nm thick. These are used for the study, by XPS, of the effects on the TiS_2 electronic structure by Na evaporation or electrochemical intercalation. Similar changes are observed in both cases; however in the latter case correlation with the cell voltage allows to quantify the impact of electronic rearrangements on the energy storage mechanism [3].

References

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Figures

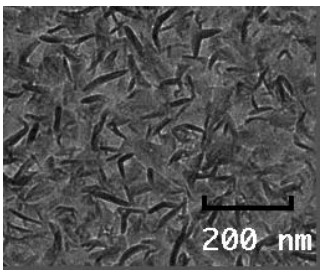

Figure 1: TEM micrographs for TiS_2 thin films deposited on a carbon-coated grid