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Metal nitride thin films synthesized by reactive magnetron sputtering for supercapacitor applications

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Electrochemical capacitors (ECs), so called “supercapacitors” are high power density devices suitable for applications needing peak loads [1]. Most of the commercially available supercapacitors are using carbon materials as electrodes. This class of ECs is named “electrochemical double layer capacitors” with a capacity limited to ~250 $F.g^{-1}$ due the absence of surface redox reactions.A new class of ECs have been developed to overcome the low volumetric capacitance, named “pseudo-capacitors” in which the stored charge arise from charge transfer at the surface of the active material. Common materials used as electrodes are metal oxides such as RuO_2, MnO_2. Besides these electrodes have been widely studied, metal nitrides have received sparse attention. Recently, VN has demonstrated impressive capacitance around 1340 $F.g^{-1}$ at 2 $mV.s^{-1}$ [2].
In this communication, we propose to study structural and electrochemical properties of binary metal nitrides elaborated by means of reactive (Ar-N_2 atmospheres) magnetron sputtering. The use of thin films enables the study of the intrinsic properties of the materials without the use of binder neither conductive additives. The structure of the films was studied by X-ray diffraction and their morphology was observed by scanning and transmission electron microscopy. The electrochemical properties were determined by cyclic voltammetry in KOH electrolyte. Despite good electronic conductivity, poor capacitance values are measured for iron and copper nitrides while RuN, MnN, CrN, TiN and VN are the most promising, with up to 300 $F.cm^{-3}$ (at 100 $mV.s^{-1}$ scan rate) measured for columnar VN dense thin film.
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