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RF magnetron sputtering deposition of TiO2 blocking layers for perovskite solar cells

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Next generation perovskite solar cells have rapidly become one of the most promising technologies in the solar energy research community. The most common architecture of this kind of sensitized solar cell device consists of a light absorber perovskite /porous TiO_2 layer which lies between an electron and a hole transport layer. It has been proven that one of the key factors for the electron transfer efficiency is the introduction of a dense TiO_2 compact layer between the anode (FTO) and the porous TiO_2 /perovskite layers since it can prevent charge recombination. The properties of the electron transport layer itself is therefore of great importance. A high density, high transparency and high conductivity TiO_2 film as well as optimized adherence and large contact area with FTO are necessary for the improvement of the cell's efficiency. Most utilized methods for the preparation of TiO_2 blocking layer, like sol-gel, spray pyrolysis etc. include high-temperature heat treatments but they are also not suitable for large scale fabrication. Moreover, for the possibility of high efficiency flexible solar cells a low temperature method must be considered. Magnetron sputtering is a clean and easily controllable technique, which can provide high quality dense and uniform TiO_2 thin films at low temperature
In this direction, a homemade high vacuum RF magnetron sputtering system with a pure Ti metal target is used in this work for the deposition of compact TiO_2 layers. We investigate the effect of sputtering parameters on the structural, optical and morphological characteristics of TiO_2 films on FTO substrates while the substrate temperature is kept below 200oC. The TiO_2 film thickness is also varied, and the films properties are evaluated in terms of the optical properties, crystalline structure, morphology and electron transport efficiency as measured from photo-generated current measurements

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