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Synthesis and deposition of $MAPbBr_3$ perovskite on titania nanotube arrays

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The organo-inorganic perovskites are materials that have recently revolutionized the field of photovoltaics due to their low-cost fabrication and high optical absorption. The hybrid organo-inorganic perovskite absorbs the visible part of the spectrum resulting in the creation of electron-hole pair. To decrease the recombination of charge carriers, the construction of solar cells requires the existence of separate layers for holes and for electrons. TiO_2 is usually used as an electron transport layer because its conduction band (CB) lies under the CB of perovskite. In that way, electrons diffuse from CB of perovskite to CB of TiO_2. For these experiments, TiO_2 nanotubular structure was used as an electron transport layer due to its advantages compared to nanoparticular TiO_2. TiO_2 nanotubes can provide a one-dimensional transmission channel for the charge carriers, so it will reduce the recombination rate of the carriers and provide a channel for fast carrier transport. However, there is a problem with the contact surface between perovskite and TiO_2 nanotubes. The aim of this study is to increase the contact surface of perovskite and TiO_2 nanotubes by filling the nanotubes with perovskite material in order to improve electron transport. Methylammonium lead bromide perovskite ($MAPbBr_3$) was deposited on anodically synthesized TiO_2 nanotubes which were annealed at 450 °C for 1 h. After degassation of the sample under high vacuum for 3 h at 200 °C, the cooled sample was put in a solution of $MAPbBr_3$ in dimethylformamide (DMF) and it was treated with inert gas (N_2), which enabled the filling of the nanotubes with perovskite material to some extent. FESEM and XRD analyses were used for morphological and chemical characterization of the sample. The diffuse reflectance spectroscopy measurement of the sample proved that deposition of $MAPbBr_3$ improves the absorption properties of TiO_2 nanotubes. By measuring the I-V characteristics of the sample in the dark and under visible light, a hysteresis curve was obtained.