# Influence of the Titanium Dioxide Nano-particles Size on the Performance of Mesoscopic Perovskite Solar Cell

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In recent years, organic–inorganic perovskite based solar cells have got substantial attention due to their low fabrication cost and excellent photovoltaic properties. Although the power conversion efficiency of the perovskite solar cells have achieved over than 20%, anomalous hysteresis in current–voltage curves remain as major challenge, which cause inaccuracy of the PCE measurements.

In this work, we use hydrothermal method to synthesize high purity anatase titanium dioxide nanoparticles, through by controlling the reaction conditions of the autoclave to synthesis of different particle size, investigate the particle size effect of titanium dioxide mesoporous layer on conventional mesoscopic perovskite solar cells, and with spray pyrolysis deposition method to prepare titanium dioxide dense layer and through the lithium (LiTFSI) doping optimized titanium dioxide mesoporous layer, improving the efficiency of electronic transmission and reducing the hysteresis of the conventional mesoscopic perovskite solar cells in the measurement effectively. The best condition with the photoelectric element of particle size for this study is 22 nm, its photoelectric conversion efficiency of reverse scan is up to 18.46%, the forward scan is 16.37%, and the hysteresis index just only 0.092.

In addition, we verify the particle size effect of titanium dioxide mesoporous by the system of fully printable mesoscopic perovskite solar cell, the results are match to the standard conventional structural trends, it is proved that the particle size of titanium dioxide in the electron transport layer is the key to the photoelectric conversion characteristics of the conventional structure perovskite solar cell. By increasing the specific surface area of titanium dioxide mesoporous layer can improve the contact area between the perovskite layer and the titanium dioxide mesoporous layer effectively, the rate of the electron injection from perovskite into titanium dioxide becomes faster, resulting in higher injection quantum efficiency after the electron-hole separation. This system has the best performance with 22 nm particle size of titanium dioxide. After optimization, the efficiency is up to 10.86% and was stable for 450 hours in ambient air; still retain 96% of original efficiency.