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Sol-gel derived and electrospun mesoporous TiO2 nanoparticles: Effects of calcining temperature on the structure, morphology and surface area

We synthesized and electrospun mesoporous titanium dioxide (mp-TiO2) particles followed by calcination at 350 oC, 450 oC and 550 oC for 4 hours. Structure, morphology, porosity and optical properties were subsequently analyzed. X-ray diffraction (XRD) analysis revealed anatase and rutile phases of mp-TiO2, observed at calcining temperature of 450 oC and 550 oC, whereas as-prepared and mp-TiO2 calcined at 350 oC showed an amorphous-like structure. Mesoporous spherical particles were observed for as-prepared sample, however, upon calcination an interconnected network of porous particles were observed. Nitrogen adsorption – desorption isotherms showed increased pore size with an increase of calcining temperature and was found to be 17.78 nm at 550 oC. Relatively higher surface area shown by Brunnauer–Emmet–Teller (BET) was increased with a decrease of particle size for a sample calcined at 450 oC and was 31.39 m2/g which suggests more surface active sites for the adsorption of molecules for improved photon absorption in perovskite solar cells. The bandgap estimation was found to be ˜3.08 eV for mp-TiO2, then upon combination with methyl ammonium lead iodide (MAPbI3), a perovskite material, approximately 2.99 eV, 2.87 and 2.99 eV bandgap values were obtained for as-prepared mp-TiO2, calcined samples at 450 oC and 550 oC, respectively. This indicate lower electron-hole recombination rates and these results correspond to Photoluminescence (PL) analysis where we observed that there is an improved charge transfer between mp-TiO2 and MAPbI3.

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yes

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