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Nanostructured SnO_2 current collectors for solar energy conversion devices: relating morphology and conductivity BENJAMIN DRINGOLI, Department of Physics, Worcester Polytechnic Institute, L. ZHOU, B. GIRI, H. JOSHI, Department of Mechanical Engineering, Worcester Polytechnic Institute, W. BELLEMAN, Department of Physics, Worcester Polytechnic Institute, P.M. RAO, Department of Mechanical Engineering, Worcester Polytechnic Institute, L.V. TITOVA, Department of Physics, Worcester Polytechnic Institute — Large bandgap (3.8 eV), high bulk conductivity, and a low-lying valence band make nanostructured SnO2 a promising candidate material for extracting photoexcited electrons from absorbers in solar energy conversion devices. Efficient charge collection requires high surface to volume ratio of a nanostructured SnO2 network, which comes at a cost of reduced conductivity due to incorporation of defects and grain boundaries, and reduction of electrical connectivity. We use terahertz time-domain spectroscopy (THz-TDS) to measure conductivity in nanoporous SnO2 films and nanowire arrays with different average lengths and packing densities. THz-TDS allows a non-contact measurement of frequency-resolved conductivity over nanoscale distances. Modeling the THz-TDS data using the the Drude–Smith model, we extract intrinsic properties of SnO2 as well as the effects of morphology on nanoscale conductivity. We find that the intrinsic carrier mobility of SnO2 making up a nanoporous film is 100 cm^2/Vs, while the nanoscale mobility is 25 cm^2/Vs. Correlating THz conductivity of nanostructured SnO2 with morphology allows us to establish optimal morphology and growth conditions for achieving highest conductivity while maintaining high surface to volume ratio.

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