

Enhancement of electrical conductivity of molybdenum incorporated TiO₂ due to sintering.

Molybdenum was incorporated into the crystal structure of TiO₂ by high temperature sintering using MoO₃ as the dopant material. Electrical conductivity of pure and Mo-doped titania were studied to obtain a qualitative estimate of change of the Fermi energy level of electrons upon doping. It is found that the electrical conductivity enhances significantly when the doped sample was sintered in a vacuum for 12 h at 1500 C.

Samples were prepared by heating a mixture of MoO₃ and TiO₂ at 5500 C for five hours in air. Mo-doped samples were prepared by varying the dopant concentration from 0.1 %-6% by weight of MoO₃. Doped samples were sintered at different temperatures for 12 h in a vacuum. The variation of electrical resistance of the samples with temperature was studied by measuring conventional two-probe AC (1 kHz and 120 Hz) resistance.

The conductivity of the doped sample enhanced as a result of sintering and its insensitive to the dopant concentration. The highest specific electrical conductivity, which is about four orders of magnitude higher than that of the undoped material, was obtained when the sample was sintered at 150 °C. The conductivity at 210 °C of Mo-doped samples sintered at 150 °C and 350 °C, and undoped samples are 4.6×10^{-6} , 1.7×10^{-8} and 3.9×10^{-10} .-1 cm⁻¹, respectively.

The activation energy of electron conduction follows the opposite trend. The lowest activation energy, which is about 40% lower than that of the undoped sample, was observed in the sample with highest conductivity. The activation energies of doped samples sintered at 150 °C and undoped samples are 0.50 and 0.83 eV, respectively.