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Gas-Sensing Properties of TiO₂ Nanoparticles Double Doped with Ag and Cu

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Nanometric powders of titanium dioxide (TiO₂) were prepared by the sol-gel synthesis of titanium isopropoxide. With Ag and Cu as dopants, single and double doped samples, at doping levels of 5% molar weight, were achieved. In addition, undoped samples were also prepared. The samples were dried in air at 100℃ and post annealing was done at 300℃ and 900℃, in order to obtain the anatase and rutile polymorphs respectively. The changes in the electrical conductivities of representative anatase and rutile TiO₂ nanopowders upon exposure to water-vapour, ammonia (NH₃) and hydrogen (H₂) were then investigated. Sensing measurements for water-vapour was done at room temperature for various humidity levels ranging from 5.4% RH to 88.4% RH. The detection of NH₃ and H₂ gases were carried out at temperatures extending from room temperature to 350℃ and over concentration ranges of 25 sccm to 500 sccm and 15 sccm to 200 sccm respectively. The gas-sensing results show that the sol-gel fabricated TiO₂ nanoparticles (particularly in anatase form), has excellent fast and stable dynamic responses to humidity, NH₃ and H₂. They feature good sensitivities, even at a low operating temperatures. However, acceptor behaviour, for which there was a conductivity switch from n-type to p-type, was recorded for the Ag-doped rutile powders at operating temperatures of 300℃ and 350℃. Overall, the double-doped sample annealed at 300℃ was deemed the most promising candidate for gas-sensing.

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