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Influence of Mn doping on the Room Temperature Gas Sensing Characteristics of TiO2 nanostructures

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Imperative increase has been observed over the years in the need of enhanced performance of gas sensor devices for the detection of toxic and combustible gases in working and living environments. The demand for accurate, fast, stable and portable devices rises with technology advances and wide application fields. Enhanced sensitivity, fast response, total recovery, and good selectivity are the main characteristics of a good sensor. With advances in nanotechnology, titanium dioxide (TiO2) nanostructures display great properties from their bulk characteristics contributing to promising sensor performance. Various processes have been attempted to modify the structure and properties of TiO2 such as sensitizing and metal ion doping in order to enhance its performance, mostly sensitivity. In this study, we report on the ultra-high sensitive and selective Mn doped TiO2 nanoparticles prepared by a microwave assisted hydrothermal method with various amounts of Mn 1.0, 1.5, 2.0, 2.5, 3.0 mol% added. Findings revealed a higher response of the Mn doped samples when exposed to NH3 gas at room temperature. The Mn doped TiO2 nanoparticles contains higher concentration of Ti3+ and singly ionized oxygen vacancies contributing to gas sensing properties. An enhanced UV–Vis emission and a broad shoulder at 540 nm were observed denoting defects induced by the substitution of Ti4+ ions with Mn2+. The Mn2+ ions improved surface activity of the sensing layer resulting in reduced gas surface chemisorption activation energy. The sensing mechanism towards NH3 gas is also proposed.

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