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Characterization of TiO₂ nanostructures prepared by microwave method for gas sensing

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1. Introduction The need for gas sensors to monitor and detect toxic, explosive and combustible gases in mines and in the environment has stimulated researchers to develop portable gas sensing devices that can detect at low concentration and at room temperature. Monitoring such gases can help to prevent occurrences of fatal accidents such as fire and explosions [1].

Amongst the metal-oxides (MOXs) semiconductors, TiO2 appears to be the most attractive material because of its diverse applications in various fields such as spintronics, solar cells, photocatalysis and gas sensors [2]. In addition, it has a good thermal stability and can operate in harsh environment. The structure and morphology of MOXs can be controlled by varying the synthesis procedure.

In this study we report the synthesis of TiO2 nanostructures using a simple hydrothermal method in NaOH solution at 220 ℃ for 15 minutes. The influence of hydrochloric acid (HCl) aqueous solution as a washing agent on the surface morphology, structure and gas sensing properties of the TiO2 nanoparticles was investigated. Additionally, the effect of calcination temperature on the properties of TiO2 nanoparticles was also studied in detail.

1. Results Fig. 1 shows the XRD patterns of the as-prepared TiO2 nanoparticles washed with distilled water and different concentrations of HCl. Based on the results in Fig 1, the structure of the starting material, P25 Degussa shows a mixture of both anatase and rutile phases. The material washed with H2O and HCl aqueous solution after synthesis reveals only the anatase phase. Previous studies reported that pure anatase TiO2 phase has comparatively good sensing properties. The SEM images of P25 Degussa compared with that washed with H2O and various concentrations of HCl aqueous solution are shown in Fig. 2. The particle sizes of the as-prepared samples increased as the concentration of the HCl as washing agent was increased as depicted in Fig. 2(c-d). The insets of figure 2 show the particle size distribution. The results revealed that when the grain size increases, grain boundaries decrease providing a large surface area thus increasing the sensing capabilities.

Are you currently a postgraduate student? (Yes/No)

YES

At what level of studies are you currently? (Hons/MSc/PhD)

MSc

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