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The nature of processes controlling the kinetics of indium oxide-based thin film gas sensor response

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Abstract

This paper analyzes the processes controlling the rate of conductivity response of In2O3-based thin film sensors to both reducing and oxidizing gases. In2O3 films with a thickness from 20 to 400nm were deposited using a spray pyrolysis method. It was established that five different processes with activation energies (Eact) of <0.1, 0.25в 0.3, 0.5в 0.6, 0.8в 1.2 and 1.2в 1.8eV controlled the transient characteristics of In2O3 conductivity responses during gas detection. The influences of operating temperature, air humidity, and film thickness on Eact were discussed. It was concluded that both water and oxygen adsorption/desorption processes were the main factors limiting the rates of response and recovery of In2O3 sensors. It was supposed that 1.2в 1.8eV corresponded to the activation energy of inter-crystallite oxygen diffusion, while 0.25в 0.3 and 0.5в 0.6eV were the energies characterizing the processes of dissociative adsorption/desorption of water and oxygen on the surface of In2O3, respectively.