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Structure and H_2 Sensing Property of TiO_2 Sputtered Films Deposited under Various Discharge Gas Pressures

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TiO_2 films were deposited by direct current (DC) magnetron sputtering under various discharge gas pressures. The structure of the films was investigated with focus on porosity, which was quantatitively evaluated on the basis of density and effective surface area. Furthermore, the H_2 sensing property of the films was investigated at different operating temperatures in ambient air. As-deposited films were amorphous. They crystallized to be of an anatase structure by annealing at 500°C. Films deposited under low pressure were smooth, whereas the films deposited under high pressure were composed of columnar grains. After annealing, the columnar grains were well defined, and the grain size increased with increasing annealing temperature. As the pressure during deposition increased, voids developed between columnar grains. The density decreased and the effective surface area increased with increasing pressure, indicating the formation of a porous film. A dense film deposited under low pressure showed sensitivity only at operating temperatures above 200°C. With decreasing density caused by increasing pressure, the sensing temperature decreased. The porous film annealed at 500°C showed a high sensitivity even at a low temperature of 100°C.

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