

Physical properties of Fe doped In₂O₃ magnetic semiconductor annealed in hydrogen at different temperature

ABSTRACT

The effects of hydrogen-annealing at different temperatures (300, 400, 500 and 600°C) on physical properties of In_{2-x}Fe_xO₃ (x=0.025) thin film were investigated. The structural measurement using XRD shows that the film has a single In₂O₃ phase structure when annealed in hydrogen at 300-500°C, however when annealed in hydrogen at 600°C the film has a mixed phase structure of In₂O₃ and In phases. The electrical measurements show that the carrier concentrations of the films decrease with the increase of hydrogen-annealing temperature in the range 300-500°C. The optical band gap of the films decreases with increasing hydrogen-annealing temperatures. The saturation magnetisation, M_s , and coercivity of films increase with the increment of hydrogen annealing temperature. The film annealed at 300°C has the lowest resistivity, $\rho = 0.03 \text{ cm}$, and the highest carrier concentrations, $n = 6.8 \times 10^{19} \text{ cm}^{-3}$, while film annealed at 500°C has both good electrical ($\rho = 0.05 \text{ cm}$ and $n = 2.2 \times 10^{19} \text{ cm}^{-3}$) and magnetic properties, $M_s = 21 \text{ emu/cm}^{-3}$.

Keyword: Hydrogen-annealing; Magnetic semiconductors; Magnetisation; Sol-gel; Resistivity