LOW-TEMPERATURE CVT SINTERING OF In_2O_3:Sn CERAMICS

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Highly conductive In_2O_3:Sn (ITO) thin films have broad prospects for light-emitting and photoconductive devices [1]. Magnetron sputtering is a relatively simple and cost-effective method for producing thin films, but this technology requires ceramic targets with high uniformity and density. The classical sintering method of ITO requires very high temperature 1500–1600 °C and special equipment [2]. The chemical vapor transport (CVT) is used for growth of indium oxide crystals at low temperatures [3]. CVT materials are easily doped [3, 4]. Recently, a new ceramic sintering method based on CVT has been proposed for ZnO [5, 6]. The development of CVT technology for ITO ceramics and thin films is of great interest.

The sintering of ITO ceramics ([Sn] = 0, 5, 10 %) by the CVT method using a In_2O_3 + SnO_2 mixed micropowders and Cl_2 as a transport agent has been developed. CVT ceramics were sintered in sealed quartz chambers at 800 °C for 12 h. For comparative analyses, classical ceramic samples sintered in air were also obtained. ITO thin films were deposited by DC magnetron sputtering with Ar as the working gas.

The advantages of the proposed sintering method are as follows: (i) low sintering temperature and cost-effective equipment including quartz as a crucible material; (ii) the use of simple and cost-effective micropowders as a material source; (iii) minimal loss of the sintered material and deviations in diameter of ceramics; (iv) higher density, hardness and conductivity; (vi) CVT ceramics can be used as targets for high-power magnetron sputtering at a current density of 40 mA/cm^2.

The presence of Cl impurity enhances the structural quality of the deposited ITO thin films. At the same, the interaction between residual Cl and the main Sn impurity is relatively weak: co-doping with Cl+Sn does not significant affect the optical and electrical properties of the films. This is explained by the low stoichiometric deviation of the obtained ceramics and low concentration of Sn halides in the thin film growth medium.

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