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Low-temperature sintering of highly conductive ZnO:Ga:Cl ceramics by means of chemical vapor transport

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Abstract

A new technology for sintering a $ZnO + Ga_2O_3$ powder via chemical vapor transport based on HCl has been developed. The proposed sintering method has the following advantages: a low sintering temperature of 1000–1100 °C, there is no need to use of expensive dopant nanopowders, the possibility of multiple re-sintering, and the absence of changes in the diameter of the ceramics after sintering. A ZnO:Ga:Cl ceramics with a density of 5.31 g/cm^3, a hardness of 2.0 GPa, and a resistivity of 1.46×10^{-3} Ω·cm has been synthesized. The solubility limit of the Ga2O3 dopant has been estimated at about 3 mol %. At a higher doping level, the content of the $ZnGa_2O_4$ spinel phase becomes significant. In addition, ZnO:Ga:Cl thin films with a resistivity of 2.77×10^{-4} Ω·cm can be grown by DC magnetron sputtering of the synthesized ceramics.