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Abstract
In this study, the sol-gel method was used to develop a manufacturing procedure for growing large area AZO (ZnO:Al) thin films with low cost and suitable for mass production. We investigated the influences of manufacturing parameters on the resistance and transmittance on the AZO thin films as well as tried to identify the key factors of these influences. Furthermore, we established a model of film growth mechanism and conducting mechanism. The best ratio of Al dopant and the influences of oxygen vacancy concentration during the manufacturing process were estimated. These can serve as the basis for further development of techniques to control the properties of thin films. ZnO transparent conductive thin films can be applied on the transparent electrode or other optoelectronic devices which require the properties of conducting and transparency at the same time.In our experiments, Zinc acetate dihydrate was used as a starting material, lsopropylalcohol and aluminum nitrate were served as the solvent and dopant sources respectively. Then, thin films were laid by dipping on a substrate of corning glass. The thickness of the films can be controlled by multilayer method. After that, we used tube furnaces combined with a vacuum pump to grow crystal and create oxygen vacancy intentionally by varying manufacturing parameters such as annealing temperatures, annealing time, and vacuum conditions, etc. By way of chemical reactions and heat treatment, ZnO thin films with high conductivity and transmittance are obtained.The experiment results show that the manufacturing process with multilayer method has enhanced the growth of crystalline on (002) plane, the ideal ratio of Al dopant was Al/Zn ≦ 2.0 at.%, and better quality of crystalline was obtained under heat treatment of 600℃. This indicates that the manufacturing process with sol-gel method has obviously improved the optical and electrical properties of the AZO thin films. For transparent conductive thin films of the best quality, the sheet resistance reached 360Ω/□, the resistance reached 1.1×10-2 Ω cm, and the transmittance in visible light area was over 80%. This means that the thin film meets the requirements for being applied onto the transparent electrode of solar cells.
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