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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. These can serve as the basis for further development of techniques to control the properties of thin films.
In our experiments, Zinc acetate dihydrate was used as a starting material, methanol and aluminum nitrate were served as the solvent and dopant sources respectively. Then, thin films were laid by spin coating on a substrate of silicom wafer. The thickness of the films can be controlled by multilayer method. After that, we used tube furnaces and Rapid Thermal Annealing combined with a vacuum pump to grow crystal and create oxygen vacancy intentionally by varying manufacturing parameters such as annealing type, 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 ratio highest of add monoethanolamine (MEA)with multilayer method has enhanced the growth of crystalline on (002) plane, and better quality of crystalline was obtained under heat treatment of annealing type. ZnO film was used the measurement of Spectroscopic Ellipsometry and UV Spectroscopic, Results show that film measurement of the film thickness、optical constants, (n, k), optical constants can obtained from the relative intensity and better or bad quality of the film to compare the XRD pattern. 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 resistance reached 2.8×10-3 Ω×cm, and the transmittance in visible light area was over 85%. This means that the thin film meets the requirements for being applied onto the transparent electrode of solar cells.
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