Spray Pyrolysis Deposition for Thin Film Formation and Its Application to the Fabrication of Transparent Conductive Oxides

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Chemical techniques for the preparation of thin films have been studied extensively because such processes facilitate the designing of materials on a molecular level. Spray pyrolysis, one of the chemical techniques applied to form a variety of thin films, results in good productivity from a simple apparatus. A solution containing starting compounds is atomized by a pneumatic spraying system at an air pressure of ∽1.0 kg/cm2. The droplets are transported onto a heated glass substrate with the compressed air. The solution is atomized not consecutively but intermittently, since the substrate temperature is lowered by the spraying. It thus takes several tens of seconds for the next spray until the substrate temperature has recovered, although the period of one spray is 0.5 to 1 s. In recent years, fluorine-doped tin oxide (FTO) and tin-doped indium oxide (ITO) have gained importance for a number of device applications. At present, and likely well into the future, these materials offer the best available performance in terms of conductivity and transmittance, combined with excellent environmental stability, reproducibility, and good surface morphology. Although ITO shows high transparency and electrical conductivity at low temperatures, when these films are exposed to the high temperature of 300°C or higher, their electrical resistance increases. The reason for this is believed to be the increase in oxygen vacancy by inclusion of oxygen from the atmosphere. In this paper, high performance transparent conductive oxides (TCO) such as FTO (Sheet Resistance, R=6 Ω/□; Transparency, T,=80%), ITO (R=1.5 Ω/□, T=82%), and FTO/ITO double-layer (ITO

inner layer is covered with FTO outer layer) (R=1.3 Ω/□, T=81%) were prepared for large size dye-sensitized solar cell fabrication by spray pyrolysis deposition (SPD) technique.