Novel conductive ZnO:Zn composites for thin film solar cell back reflectors application

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Abstract

Dielectric thin films of high- and low-refractive index are the essential building blocks for optical coatings considering solar cells applications [1]. In order to achieve high sputtering rates and superior film quality, novel conductive ZnO:Zn composites have been developed, which become conductive once the metal Zn reach a critical ratio, as presented in Fig. 1.

Optimized ZnO:Zn produced target have been characterized and used to sputter optical conducting films that were then studied for structural, optical and electrical properties characterization. Experiments on solar cell using ZnO:Zn sputtered thin films were also conducted.

When conductive particles are dispersed into a nonconductive matrix and the amount of the conductive phase increases from zero up to a critical volume fraction of percolation [2], one particle contact with neighbors and form finite conductive path where the host material is non-conductive. Near the critical volume, a conductive network is formed and the resistivity of the entire composite abruptly decreases.

The critical fraction of the conductive Zn phase is ~20% in weight in the present study. SEM/EDX analysis was performed to confirm this assumption. Transmittance spectra of ZnO films prepared by RF sputtering from ZnO:Zn displayed similar transparency as other typical used optical coatings.

References

[1] H.A. Macleod, Thin-Film Optical Filters, Third Edition, IOP Publishing, Bristol and Philadelphia (2001)
[2] D. S. McLachlan, M. Blaszkiewicz and R. E. Newnham, J. Am. Ceram. Soc. 73, 2187 (1990).

Figures

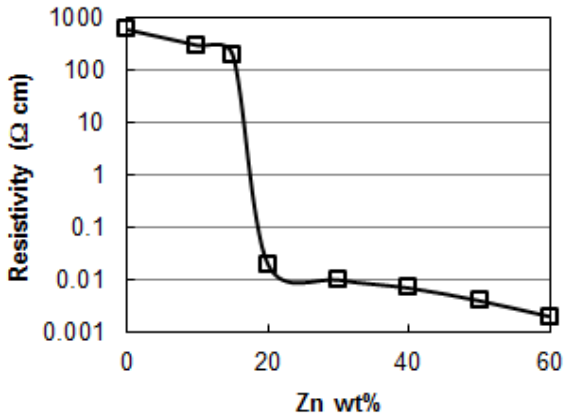

Fig.1 Resistivity versus x value for (1-x)ZnO+xZn compositions.