EMCMRE-1
Marrakech-Morocco
November 21-25 2011
First Euro-Mediterranean Conference on Materials and Renewable Energies (EMCMRE-1) 21-25 November 2011

Morphology Optimization of PLD-grown CuO Films for Solar Energy Devices

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Abstract:

In recent years, cupric oxides (CuO) thin films have attracted much interest as a promising material for solar energy devices due to its photo-electrochemical properties (bandgap 1.2-1.5 eV). Solar energy devices request layering of very high-quality thin films with minimal surface morphology and optimized crystalinity. Such epitaxial growth is not trivial for CuO due to the complex crystallographic symmetry of the CuO network since CuO is monoclinic (a=0.4684 nm, b=0.3425 nm, c=0.5129nm, β=99.471).

Although structural analysis and the characterization of the physical properties of CuO thin films have been widely reported, to our knowledge, few of them were grown by pulsed laser deposition (PLD). In this work CuO films were grown using PLD in five different sets. First set was grown on four different substrates, STO(100), MgO(100), Sapphire(0001) and Silica(0001) at given temperature and pressure. Second set was grown on MgO (100) at various substrate temperatures, the third grown at different gas pressures, the fourth grown at different substrate-target distance and the fifth set was grown at different laser energy densities.

The grown films were imaged by AFM to trace their morphology with the variation of process parameters. The results present the optimization of film morphology by adjusting surface kinetics, PLD plume dynamics and laser energy density.