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Cu_2O thin films obtained from CuO films treated under an argon/dry-air microwave plasma

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Cu_2O is a promising material for solar cells, its synthesis is generally complicated, however. Pure Cu_2O thin films can be obtained from CuO films using an argon/dry-air plasma treatment. CuO is reduced to a form of metastable metallic copper that readily oxidizes to Cu_2O. Depending on different process conditions, the crystallite size of Cu_2O can be increased and controlled. Different groups of CuO samples, obtained by sol-gel deposition on glass, were annealed at different temperatures (*TA*), from 350 °C to 550. To obtain Cu_2O, CuO thin films were treated for 15, 20, 25 or 30 s, under an argon/dry-air plasma. The treatment took place at low pressure (15 mbar), inside a quartz chamber in a home-made equipment consisting of a 1500 W microwave oven modified for this purpose. The samples were placed on a ceramic plate that allowed both substrate sides to receive the same plasma treatment. Fluxes of argon (60 SSCM) and dry air (60 SCCM) were controlled by mass controllers and injected continuously before, during and, after the plasma treatment. Depending on the CuO films TA's, gas flows and time of plasma treatment, Cu_2O, Cu or a mixture of both were obtained. Interestingly, pure Cu_2O was produced only from a metastable form of metallic copper and only after the plasma treatment, this by oxygen availability. To our knowledge, this phenomenon has not been reported before. CuO annealing temperatures showed that Cu_2O crystallite sizes tended to be bigger when lower TA's were used; wide variations in crystallite size were observed. Pure Cu2O films of 100 nm in thickness with bandgap of 2.17 eV were obtained by a plasma treatment of 30 s. Some of the advantages of this plasma processing are its simplicity, short time of treatment and, low cost of the home-made equipment.

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