Modifications in SnS thin films by plasma treatments.

David Avellaneda\textsuperscript{1}, Horacio Martínez\textsuperscript{2}

\textsuperscript{1}Instituto de Ciencias Físicas - UNAM, Cuernavaca, Morelos, Mexico \textsuperscript{2}Instituto de Ciencias Físicas, Cuernavaca, Morelos, Mexico
daa@cie.unam.mx

This paper presents the modifications of the structural, optical and electrical characteristic that occurs in tin sulfide (SnS) thin films treated in air and nitrogen plasma at different conditions of pressure, voltage and current. The films were obtained from the chemical deposition method, in a solution containing Sn(II) complex ions, thioacetamide, thiourea and ammonia; this solution was maintained at 60 °C, for 6 h, which results in SnS thin films of ~ 500 nm in thickness, with an orthorhombic crystalline structure, band gap ($E_g$) of 1.1-1.2 eV, and electrical conductivities ($\sigma$) in the order of $10^{-6} \ \Omega^{-1} \ cm^{-1}$. The air plasma treated thin films, at pressures between 1 Torr and 3 Torr, results in the presence of the phases SnS\textsubscript{2}, Sn\textsubscript{2}S\textsubscript{3}, and SnO\textsubscript{2}, in the films, showing band gap values ranging from 0.9 to 1.5 eV. In the case of nitrogen plasma treated thin films, the most important change is in the electrical conductivity, which increases from $10^{-6} \ \Omega^{-1} \ cm^{-1}$ (as prepared) until $10^{-2} - 10^{-3} \ \Omega^{-1} \ cm^{-1}$ (plasma treated), which is a suitable range of conductivity for the improvement of the solar cells with SnS as an absorber material. Emission spectroscopy measurements were carried out in both air and nitrogen plasma treatments.

Keywords
Tin sulfide  
Chemical deposition  
Plasma treatment  
Thin film  
Emission spectroscopy