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Optical properties of metal sulfide nanostructures

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Metal sulfide nanostructures are materials with promising applications in energy conversion and storage. Among these materials are Silver and Copper Sulfides that have been widely used in solar cell devices. Great efforts have been dedicated to the synthesis of these materials and their morphological control. The reported synthesis methods include several routes such as hydrothermal, sonochemical and solid-vapor reactions. Nanostructured arrangements on substrates are very attractive due to their enhanced properties and the easiness of further applications in devices. High surface area structure for light trapping and solar cell efficiency improvement are desired. In this work, high surface area nanostructures of Copper Sulfide and Silver Sulfide were successfully synthesized on metallic substrates by simple solid-vapor reactions. The effect of temperature and time in the synthesis and control of these nanostructured materials was studied as well as their influence in the optical properties. Time and temperature were varied from 2h to 40 h and 75 to 110oC. Ag2S (acanthite phase) was obtained for the Sulfur-Silver System. For the Copper-Sulfur system, Cu2S (chalcocite) and CuS (covellite) were obtained at 75oC and 110oC, respectively. Optical band gaps and the type of electronic transitions were determined by means of the optical absorption spectrum from 0.5eV to 5.0eV, using the Kubelka-Munk function F(R). Results showed that the synthesized nanostructures exhibits band gaps near to 1.1eV which is the reported optimal value for solar cells applications.

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