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Thickness, Temperature and Magnetic Field Dependent Resistance of $Cu_{1.8}S$

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Extended Abstract

Copper sulphides (Cu_xS, $1 \leq x \leq 2$) exhibit an extensive range of optical and electrical properties as many as their meta-stable phases and structures [1-4]. Stoichiometric ratio of Cu and S can be tuned by changing synthesis conditions. Most copper rich Cu_xS compounds are known as semiconductors with a 1.2 ~ 2 eV direct/indirect band gap. Although lots of practical studies have been made for energy storage [5] and photovoltaic device applications [6], their electrical properties at low temperatures in the presence of magnetic fields are rarely reported so far. Here, we report electron transport properties of Cu1.8S thin films varying temperature and magnetic fields. Furthermore, we demonstrates surface effects as the thickness varies.

Cu thin films with different thicknesses are deposited on c-plane sapphire substrates (0001) by using RF magnetron sputtering. The purity of the used Cu target is 5 N, and base and working pressures are ~ 10^{-7} and 10^{-2} torr, respectively. The pristine sputtered Cu films are exposed to H2S at room temperature and annealed at 250 ℃. The thickness of the films is measured by atomic force microscopy (AFM) and found to be ~ 5, 15, 30, and 50 nm. The $Cu_{1.8}S$ phase is confirmed by grazing incidence X-ray diffraction (GIXRD) with less than 1 degree incidence angle. Collinear 4-point measurements are performed between 7 K and room temperature, in order to investigate their electrical properties. Magnetic fields up to 1 Tesla are applied and magnetic properties are investigated at various temperatures. Intriguing phenomena such as metal insulator transition (MIT) and magnetic phase transition are observed as the thickness varies.

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