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Study of conductivity of p-CuSCN doped with halides

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Copper thiocyanate (CuSCN) is a compound semiconductor with band gap of 3.6 eV possessing p-type conductivity. This material is soluble in slightly acidified acetonitrile or propyle sulfide. Thereby methods such as dip coating and spin coating could be adopted to deposit thin films of CuSCN. However to make this material practically useful, doping is essential to improve its hole conductivity. Inclusion of SCN ions into the bulk is believed to improve the p-type conductivity. We have noticed that the exposure of these films to halogen gasses such as Cl_2, Br_2 and I_2 seems to improve the p-type conductivity.

Thin films of CuSCN were deposited on micro glass slides (1.5x1 cm^2) by dip coating CuSCN in propyle sulfide. These films were introduced into a cell containing halogen gass (Cl_2, Br_2 or I_2). The changes in the sheet resistance of the films were measured with Keithley multimeter.

A single dip coated CuSCN film on glass substrates has an average thickness of ~1 μm and sheet resistant of ~ 120 MΩ/□ at room temperature. It was noticed that the CuSCN film doped with Cl_2 attained the lowest sheet resistance of 0.5 MΩ/□ and the film doped with I_2 decreased only to 40 MΩ/□. Compared to film doped with I_2, the film with Br_2 also reached to a lower value (1.8 MΩ/□). This can be explained on the basis of the molecular size and reactivity of each halide. As the I_2 molecules are large and less reactive, which exist as a solid at room temperature penetrate weakly into the bulk. But inclusion of Cl_2 to the CuSCN film replaces some of the lattice SCN with Cl, making SCN available excess in the bulk. Br_2 also reacts with CuSCN making excess SCN in the bulk.

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