P-type transparent conductors

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Abstract

Two approaches were taken towards the fabrication of transparent p-type materials. In one study, the cosubstituted solid soln. $In_{2-2x}Sn_xZn_xO_{3-\delta}$ was p-doped with Zn^{2+} to form $In_{2-x-y}Sn_xZn_yO_{3-\delta}$ (y>x). A 4% Zn^{2+} excess can be introduced in $In_{1.6}Sn_{0.2}Zn_{0.2}O_{3-\delta}$ while maintaining the bixbyite structure. Zn-doped $In_{1.6}Sn_{0.2}Zn_{0.2}O_{3-\delta}$ was annealed under high O pressure (.apprx. 170 atm) to eliminate anion vacancies V0-. Owing to a decrease in carrier concn. by up to two orders of magnitude from 1020 to 1018 carriers/cm3, the cond. of the annealed material decreases. Hall measurements show that the carriers remain n-type. The results imply the existence of neutral Zn-Vo- complexes that prevent the donation of holes by Zn^{2+}. A 2nd approach resulted in a new low temp. hydrothermal synthetic technique that was successfully applied to delafossite materials, including $CuAlO_2$. Samples of p-type $CuAlO_2$ have as-pressed conductivities three orders of magnitude greater than those prepd. by conventional high-temp. solid state techniques.

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