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Summary

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In the last decade, a large number of high value added high-tech materials are available which exhibit or deliver superior mechanical, electrical, magnetic and optical properties. These are now commercially produced from readily available materials such as oxides, nitrides, carbides of iron, zirconium, titanium, aluminium, silicon, etc. through the optimization of many process parameters. The experimental research efforts on high-tech ceramics are focussed on what happens to these products at atomic, molecular or crystal level during their synthesis, processing, characterization and extensive usage. Physicochemical characterization of cadmium oxide ceramics dealing with synthesis, electronic processes and thick film form are therefore carried out in our laboratory.

The synthesis of $\text{Cd}_{1-x}\text{Mn}_x\text{O}$ system was carried out by usual decomposition reaction, monitored through simultaneous DTA/TG/DTG plots. The X-ray diffraction studies of the prepared composition showed that the system exhibits cubic crystal structure. The lattice parameter values of the compositions are close to the reported value of CdO. The X-ray diffraction studies of the aged samples clearly revealed the presence of

CdCO_3 and Cd(OH)_2 . These phases grow during the aging period by the action of CO_2 and H_2O on CdO .

The extensive EPR studies of the $\text{Cd}_{1-x}\text{Mn}_x\text{O}$ system are carried out for the first time. All the g values obtained for the EPR signal observed in the system are comparable with the reported g values of different paramagnetic centers present in a variety of non-stoichiometric specimens of CdO .

The observations of hyperfine and superhyperfine lines for this system showed that Mn^{2+} ions occupy substitutional site in nearly cubic environment of oxygen octahedra in CdO . Further, the observation of superhyperfine lines suggested that Mn^{2+} electrons are delocalized to give superhyperfine interactions with the nearest neighbouring Cd nuclei of nonzero spin. The spin Hamiltonian parameters are comparable with that reported for other cubic system.

The aged sample of the system showed an additional signal at $g = 2.778$ corresponding to the Mn^{2+} ions present in the impurity phases. The aged sample also showed an additional hyperfine sextet growing with the aging period. This sextet is likely to arise from Mn^{2+}

ions in the impurity phase of CdCO_3 .

Thick films of CdO were prepared by using different types of binder. The concentration of the binder varied from 0 to 10 wt %. The X-ray diffraction studies of the films showed the presence of impurity phases of CdCO_3 and Cd(OH)_2 . The variation of lattice parameter for the films of CdO indicated the oxidation of Cd^+ ions to Cd^{2+} ions during the firing process. The films of CdO-GL-1 also showed similar changes and indicated the incorporation of Pb^{2+} ions into the lattice of CdO at firing temperature of 600°C . The films of CdO-GL-3 showed continuous decrease in the lattice parameter values and decrease in the concentration of Cd^+ . In the case of CdO-GL-2 films, increase in the lattice parameter value is observed. This is explained on the basis of controlled valency process similar to that observed in ZnO:Ga^{3+} system.

The grain growth in thick films of CdO fired in the temperature range of $600\text{--}900^\circ\text{C}$ is observed for the first time. The comparison of these studies with the reported data of related system suggests that the grain growth is most likely due to the volume diffusion resulting from impurity drag.

The variation of sheet resistivity of thick films of CdO is explained on the basis of oxidation of Cd⁺ ions to Cd⁺⁺ ions and electron scattering at grain boundaries. The influence of the binder on sheet resistivity values of the films is discussed.

In conclusion, Mn²⁺ ions are found to be an excellent EPR microprobe to monitor the local environment and stoichiometry in bulk CdO and CdO is prospective candidate for its wide usage as a conducting material in thick film resistors.