

**OPTO-ELECTRONIC AND ELECTROPHOTOGRAPHIC
PROCESSES IN BINDER LAYER SYSTEMS**

BY

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DEDICATED

TO

MY BELOVED PARENTS

AND TO

MY BROTHER AND SISTERS

Research Supervisor

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ABSTRACT

The main emphasis of the present work has been on the evaluation of the electrophotographic properties of binder layers. These properties of $\text{HgI}_2:\text{CdS}$ mixed system and red mercuric oxide binder layers, and of poly-9-vinylanthracene have been investigated. Apart from this, study of the photoconductivity, photoelectrets and photodielectric effect is also reported. This gives an insight into the charge carrier generation, transport, mechanism of trapping and distribution of traps. The above effects have also been studied in pellets of ZnTe , $\text{ZnTe}:\text{Cu}$, $\text{ZnTe}:\text{In}$ and $\text{ZnTe}:\text{Mn}$, and in pellets and binder layers of yellow mercuric oxide.

The mode of conduction of carriers is estimated from the current-voltage characteristics and its dependence on temperature and intensity of illumination. Further, from the nonlinear current-voltage characteristic a trap density of $\approx 10^{10} \text{ cm}^{-3}$ was estimated for the 60:40 composition (with 60% of polystyrene binder) of the $\text{HgI}_2:\text{CdS}$ mixed system. Also, from the ohmic-SCLC transition voltage, the thermal free carrier density in 60:40 composition (with 100% polystyrene binder) of $\text{HgI}_2:\text{CdS}$ is determined to be $\approx 10^{23} \text{ cm}^{-3}$. Studies on the intensity dependence of photocurrent in $\text{HgI}_2:\text{CdS}$ mixed system, red mercuric oxide and $\text{ZnTe}:\text{Cu}$ showed a continuous distribution of traps. Whereas, ZnTe , $\text{ZnTe}:\text{In}$ and $\text{ZnTe}:\text{Mn}$ showed sublinear photocurrent-intensity dependence. Quadratic recombination is observed to take place in most of the samples. Further,

activation energies were evaluated from the temperature dependence of dark and photocurrent. The photoconductivity characteristics of the mixed system ($\text{HgI}_2\text{:CdS}$) were found to depend on the composition and binder content. The 60:40 composition of $\text{HgI}_2\text{:CdS}$ with 60% polystyrene binder, was found to have optimum photoconducting characteristics.

The study of persistent internal polarization reveals the nature of trap centres. Homocharge was observed in red mercuric oxide, ZnTe , ZnTe:In and ZnTe:Mn pellets. This was due to carrier injection from the electrode into the samples. Further, thermophotovoltaic behaviour was observed in red mercuric oxide pellet.

A study of photodielectric effect (PDE) gives the conduction mechanism in the sample under ac field. The observed large increase ($\sim 100\%$) in capacitance of $\text{HgI}_2\text{:CdS}$ is due to the cumulative effect of photoconduction and space charge polarization. The photodielectric effect is explained on the basis of space charge polarization and polarization of trapped carriers.

The $\text{HgI}_2\text{:CdS}$ mixed system was found to have good electrophotographic characteristics. To decrease the dark discharge of the mixed system, a double layer of $\text{HgI}_2\text{:CdS}$ coated with amorphous selenium, was made. This was found to have excellent characteristics. The CdS:Se double layer system was observed to have the best electrophotographic properties. Binder layers of red mercuric oxide with polyacrylonitrile-butadiene-styrene (ABS), silicone resin,

polystyrene and ethyl cellulose were also studied. It was observed that the binder layer of red mercuric oxide with polyacrylonitrile-butadiene-styrene binder possessed the best electrophotographic properties. Poly-9-vinylanthracene and its double layer with poly-n-vinyl carbazole have good performance. It was also observed that the initial surface potential, discharge rate and electrophotographic gain of the $\text{HgI}_2:\text{CdS}$ binder layer depend on the thickness of the layers.

The x-ray diffraction, optical and infra-red absorption spectra were studied. The x-ray diffraction pattern was found to vary with composition of the $\text{HgI}_2:\text{CdS}$ mixed system. The core levels in poly-9-vinylanthracene (P9VA) have been determined. Furthermore, from the infra red absorption spectra the various organic groups in the structure of P9VA have been identified.

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