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Mercuric iodide crystals for X- and gamma- rays detectors.

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Abstract – Mercuric iodide crystals are obtained by solvent evaporation technique. Different ambient condition and solvent were tested. Using ethanol and tetrahydrofuran (THF) as a solvents, regular and non-regular crystals could be obtained. Structural, morphological, optical and electrical studies are shown.

Mercuric iodide (HgI_2) has been investigated for X- and gamma-rays room temperature detectors in last decades. This material has different phase transitions, however red HgI_2 (α-HgI_2) has the necessary properties for this intent. Its properties are wide optical band gap (2.13 eV), high atomic number (Z_{Hg}=80 and Z_I=53) and high density (6.4g/cm^3) [1]. Besides, it has higher optical window for these radiation. In this work we obtained crystals of HgI_2 by solvent evaporation technique.

Ours crystals were obtained by solvent evaporation technique that consists in evaporation of volatile solvent in solution prepared with HgI_2 salt. The solution is put in a becker and covered with PVC-film to control of evaporation rate. After total solvent evaporation, crystals of different sizes and regular forms are formed on the bottom becker. Two conditions were tested: i) in dark and ii) in light presence. The experimented solvents were ethanol and tetrahydrofuran (THF). The solutions were prepared with the concentration of HgI_2 of 15mg/ml for each solvent.

The crystals were submitted to different structural, optical and electrical measurements. The figure 1a) displays photoluminescence for ethanol crystals in dark and light conditions. In the spectrum, it is observed the presence of transitions that are called band I, band-tail and band II [2-3]. The figure 1b) shows the relations of the integrated area between band-I and other transitions. Band I is the consequence of excitonic transitions, as many free-excitons as bound-excitons [2]. The contributions for free and bound-excitons may be separated by Gaussian curves and this result is seen in figure 1b). The contributions of bound-excitons are the principal transitions related to band I for both dark and light conditions. For light, a little contribution is observed for free-excitons. For band-tail, that is related with structural defects caused by anions (iodine) [3]. This transition is observed for the two conditions, but there is smaller than excitonic transitions. Finally, we may observe a contribution for band II only for light crystals. This band are related with lack of Hg or I atoms.

In figure 2 we may see electrical behavior for the crystals obtained by ethanol and THF. The figure 2a) displays a current density – electrical field curves for ethanol and THF crystals. The resistivity is shown in figure 2b) that are 1.10^{9}Ω.cm and 2.5.10^8 Ω.cm for ethanol dark and light crystals and 7.10^{8}Ω.cm and 1.10^9 Ω.cm for THF dark and light crystals.

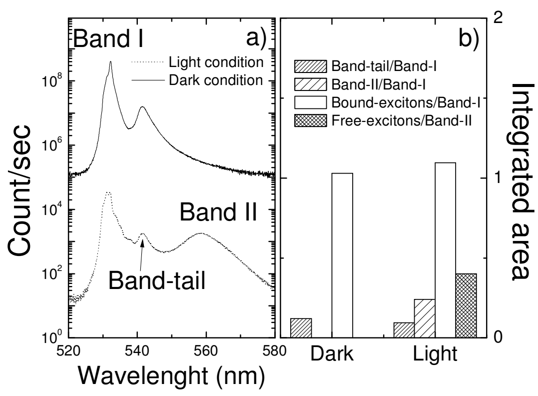

Figure 1: a) Photoluminescence for crystals in light and dark conditions and **b)** Relation of transitions bands and band I.

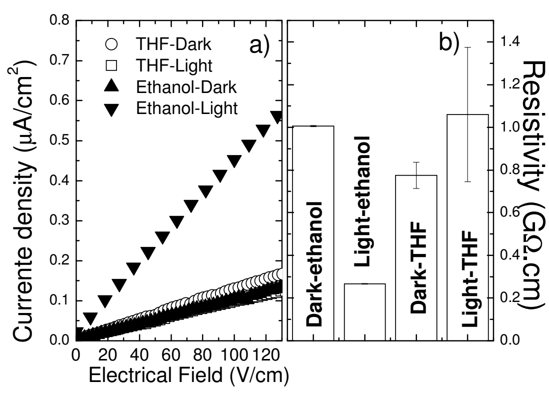

Figure 2: a) Density current – electrical field curves for Ethanol and THF crystals. **b)** Resistivity for the crystals.

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