INTRODUCTION

Mercuric iodide is a promising compound semiconductor that is being studied as a photoconductor for gamma and X-ray digital imaging.

Several studies of the contacts properties were reported for detectors made with single α-Hgl₂ crystals but not with Hgl₂ polycrystalline films.

The barrier height (Φ) of the Metal– Semiconductor (MS) interface:
- Controls the electronic transport across the MS interface
- Depends on the surface states (surface quality)
- Depends on the metal work function

OBJECTIVE

We report here for the first time the study of Φ (at zero bias) of contacts and the image force lowering of Φ (∆Φ) (Schottky lowering effect) for different materials used as electrodes in detectors made with α-Hgl₂ polycrystalline films, grown by the PVD method.

EXPERIMENTAL

Films growth

Starting material: Hgl₂, Aldrich + 4 sublimations

Growth method: PVD (Physical Vapor Deposition)

Conditions:
- Source Temperature: 135 °C
- Substrate Temperature: 45 °C
- Growth time: 2 days
- Initial pressure: 6.5-7.5 x 10⁻³ Pa
- Substrates: glass coated with different materials
- Materials used as contacts: Pd, C (aquadag (Aq)), ITO, Cu, Zn, Mg, Al, Au, Ag

All films were grown under similar conditions and from the same starting material in order to suppress the crystalline quality as a variable.

Detectors assemblage on the as-grown films

The same material (Pd, Ag) than for rear contact was deposited for the front one.

Pd was used as front contact when ITO was the rear one.

Also, Ag was used as front contact when Pd was the rear one.

Electrodes with and without guard ring (GR) were made for avoiding surface leakage currents.

Detectors were named as A-B (A rear contact material, B front contact one).

Characterizations:

- Optical Microscopy
- Film thickness
- Stabilization time (dark current density (j) vs time)
- Dark current density (j) vs applied field (E)

From the curves were obtained the following parameters:

- j vs E
- Resistance ρ (Ω•cm)
- Ln(j) vs E² (V/cm)
- Barrier contact height Φ (eV)
- Decrease of barrier height (∆Φ)

RESULTS AND DISCUSSION

j varies dramatically in the first minutes following the first application of the voltage bias.

After detectors have been biased for the first time, they required a stabilization time of about 5 min.

There is a leakage current along the surface of the films for detectors made without GR.

The following results and conclusions are taken from detectors made with GR.

### Richardson constant for Hgl₂

\[
j = A T^2 e^{-\frac{q(\Phi - \Phi_A)}{kT}}
\]

Richardson constant for Hgl₂:

\[
A = \frac{q^3 E}{4 kT e^2}
\]

<table>
<thead>
<tr>
<th>Detector</th>
<th>Pd-Pd</th>
<th>Pd-Aq</th>
<th>Ag-Aq</th>
<th>ITO-Pd</th>
<th>Cu</th>
<th>Mg</th>
<th>Zn</th>
<th>Au</th>
<th>Ag</th>
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</thead>
<tbody>
<tr>
<td>ρ (Ω•cm)</td>
<td>1.1x10⁻³</td>
<td>8.5x10⁻³</td>
<td>3.1x10⁻³</td>
<td>8.7x10⁻³</td>
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<td>q (eV)</td>
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<td>1.01</td>
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<td>0.69</td>
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<td>∆Φ (mV)</td>
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<td>0.035</td>
<td>0.050</td>
<td>0.029</td>
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<td>E (kV/cm)</td>
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<td>0.053</td>
<td>0.074</td>
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</tbody>
</table>

Reactions

- No
- Yes
- Yes
- Yes
- Yes
- Yes
- Yes

The lowest barrier height obtained was the one of ITO contacts, which will be taken into account for further film growth (onto ITO coated substrates) and for the detector assemblage (front contact ITO), especially for optical applications of Hgl₂ films.

The obtained values for the different parameters are in the order of the reported ones for detectors made with Hgl₂ single crystals, indicating a similar behavior between the monocrystal and the polycrystalline surfaces.

We can conclude that, although polycrystalline and without any kind of treatment, the Hgl₂ film surface does not substantially modify the MS barrier height related to the one of an etched monocrystal, that means that monocrystals and films seems to have similar energy levels at surface.

Future work will be focused on the study of the influence of the etching on the energy levels at surface, and on the barrier height on the response of the detectors to radiation.