Vapor Growth of Indium Monodiode
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Introduction
Indium (I) iodide, InI, is part of a group of heavy metal iodides that can be used as room temperature radiation detectors [1-4]. Other examples are HgI, PbI, BiI, or TPBI [1]. InI has several advantages, such as low toxicity, no solid phase transition (such as in HgI), and no tendency to form polytypes (PbI, BiI). All binary iodides have layered structures and are quite soft, but InI is also the mechanically most stable compound of the binary compounds. Table 1 shows the main properties of InI in comparison with the other iodides and the most common room temperature radiation detector material, (Cd, Zn)Te.

Vapor Growth
After heating up the furnace and temperature stabilization at the TC positions, typically taking 6h, translation was initiated. To save time, the initial translation rate was 6mm/h, which was then reduced stepwise down to 1.5 or 1.2mm/h, as indicated by the grey curve in fig. 4.

Vapor Growth Results
Typical growth times of 5-6 weeks resulted in crystals of 1.5-3cm length for both the closed and the semi-closed setup. The crystals are partly or completely faceted and transparent in the red region of the spectrum (figs. 5a,b,c). Structural and electric characterization of the crystals in comparison to Bridgman-grown crystals is planned.

Thermal Properties of InI
In addition to the vapor growth, the anistropic thermal expansion of InI has been determined for temperatures between 25°C and 220°C by X-ray diffraction measurements of the 002, 200, and 008 diffraction peaks using a Panalytical X Pert diffractometer. Figs. 6 shows the change of the lattice constants with temperature. The RT values for the lattice constants were in very good agreement with the values from Meyer et al. [15] and also close to the values of Sidorov et al. [16], as indicated in the graphs. The resulting linear thermal expansion coefficients are: αL = 11.00"10−6 K−1, αC = 8.00”10−6 K−1, and αH = 6.20”10−6 K−1. Sidorov et al. [16] determined the InI thermal expansion coefficients for the temperature range 51 K to 310 K. For RT, their values were: αL = 11.0"10−6 K−1, αC = 8.0"10−6 K−1, and αH = 6.2"10−6 K−1, which is in reasonable agreement with our results. Several authors also proposed solid state phase changes for InI at 150°C and 210°C [17,18], based on Raman spectroscopy [17] and DTA [18] measurements. Others authors [20,21] disputed that, explaining the measured signals with InI impurity reactions. Apart from the peak shift due to the lattice expansion, no change in the diffraction peak indicated in the graphs. The resulting linear thermal expansion coefficents are:

<table>
<thead>
<tr>
<th>Material</th>
<th>ρ (g/cm³)</th>
<th>T (°C)</th>
<th>Linear expansion coefficient (×10⁻⁶ K⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>InI</td>
<td>1.32</td>
<td>22.0</td>
<td>αL = 11.00 (lattice), αC = 8.00 (crystal), αH = 6.20 (molar)</td>
</tr>
</tbody>
</table>

Table 1: Physical properties of metal iodides used for radiation detection in comparison to (Cd, Zn)Te

Vapor Growth Setup
InI sublimates congruently, the vapor consists mostly of InI monomers [11,12]. In fig. 1 shows the calculated vapor pressures over solid and liquid InI as a function of temperature. The vertical growth ampoule is shown in fig. 2. A fused quartz frit sits inside the frit source (frit) and subsequent growth.

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