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In_2Se_3 phase transitions at high pressure and high temperature

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Indium selenide (In_2Se_3), a III-VI semiconductor and phase change material, has potential for use in phase change memory devices. Multiple crystalline phases of In_2Se_3 are stable or metastable under atmospheric conditions and transitions between the phases can be induced through either thermal or optical stimulations. However, large stresses on a phase change material in a memory device could affect the phase switching behavior of the material. Therefore, it is important to understand both the thermal and elastic properties of In_2Se_3 to achieve controlled switching between phases. We are studying the pressure-dependent structural properties of In_2Se_3 powders and nanocrystals using synchrotron x-ray diffraction and a diamond-anvil cell. In previous works we have reported on two pressure-induced phase transitions in In_2Se_3. The α to β phase transition occurs at 0.7 GPa, an order of magnitude lower than critical pressures observed in other semiconductors. The size dependent γ to β phase transition occurs between 2.8 GPa and 3.2 GPa in bulk powder samples and at slightly higher pressures, between 3.2 GPa and 3.7 GPa., in nanowire samples. Now we report our preliminary findings on how pressure affects the thermal phase transitions of In_2Se_3. A diamond anvil cell outfitted with an external heater was used to observe phase transitions in In_2Se_3 samples under high pressure and high temperature conditions.

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