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The Absorption Properties of p-Type  $\text{TlIn}_x\text{Ga}_{(1-x)}\text{Se}_2$  and  $\text{TlGaSe}_2$

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**Abstract:** p-TlGaSe<sub>2</sub>, p-TlIn<sub>0.3</sub>Ga<sub>0.7</sub>Se<sub>2</sub> and p-TlIn<sub>0.5</sub>Ga<sub>0.5</sub>Se<sub>2</sub> single crystals were grown by the modified Bridgman-Stockbarger method in our crystal growth laboratory. The absorption measurements were carried out on p-TlIn<sub>x</sub>Ga<sub>(1-x)</sub>Se<sub>2</sub> samples in temperature range 10-300 K in steps of 10 K. The binding energies of p-TlGaSe<sub>2</sub>, p-TlIn<sub>0.3</sub>Ga<sub>0.7</sub>Se<sub>2</sub> and p-TlIn<sub>0.5</sub>Ga<sub>0.5</sub>Se<sub>2</sub> were obtained as 35.0 meV, 16.5 meV and 14.5 meV, respectively. The direct band gaps were calculated as 2.244 eV, 2.195 eV, 2.164 eV in p-TlGaSe<sub>2</sub>, 2.158 eV, 2.131 eV, 2.098 eV in p-TlIn<sub>0.3</sub>Ga<sub>0.7</sub>Se<sub>2</sub>, and 2.107 eV, 2.075 eV, 2.019 eV in p-TlIn<sub>0.5</sub>Ga<sub>0.5</sub>Se<sub>2</sub> respectively, at sample temperatures of 10 K, 140 K and 300 K. The indirect band gaps were calculated as 2.196 eV, 2.127 eV, 2.073 eV in p-TlGaSe<sub>2</sub>, 2.130 eV, 2.101 eV, 2.064 eV in p-TlIn<sub>0.3</sub>Ga<sub>0.7</sub>Se<sub>2</sub> and 2.090 eV, 2.054 eV, 2.004 eV in p-TlIn<sub>0.5</sub>Ga<sub>0.5</sub>Se<sub>2</sub> respectively, at 10 K, 140 K and 300 K. There is an abrupt change in the energy peak for p-TlGaSe<sub>2</sub> in the temperature range 135-150 K. The values that we obtained from the energy peak change may be at a phase transition temperature.

**Key Words:** TlGaSe<sub>2</sub>, TlIn<sub>0.3</sub>Ga<sub>0.7</sub>Se<sub>2</sub>, TlIn<sub>0.5</sub>Ga<sub>0.5</sub>Se<sub>2</sub> single crystals, absorption, binding energy, phase transition.

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