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Thermal properties and optimization of process parameters for the growth of silver thiogallate crystal by differential scanning calorimetry

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Abstract: In present work, thermal properties of silver thiogallate ($AgGaS_2$) crystal were investigated by means of differential scanning calorimetry (DSC) measurements performed at different heating and cooling rates. The DSC results confirmed that the melting point was 1249 K with a slight change around 5 K and that the nucleation temperature varied from 1183 K to 1218 K. The supercooling temperature was evaluated in the range 37.69 K to 62.46 K which was considered to be harmful for the single nucleus formation at the beginning of crystal growth. The activation energy E and the pre-exponential factor A were also calculated using different isoconversional methods, namely Kissinger-Akahira-Sunose (KAS) method and Flynn-Wall-Ozawa (FWO) method, and the results showed good agreement with each other. According to the results of DSC, a larger temperature gradient up to 30K/cm was utilized to suppress the formation and growth of multi nuclei and a rapid cooling rate 25 K/min was applied to minimize the second-phase precipitates during the process of crystal growth. Finally, an integral and transparent $AgGaS_2$ single crystal with diameter of 22 mm and the length of 55 mm was obtained.

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Keywords: B1. $AgGaS_2$; A1. thermal properties; A1. differential scanning calorimetry; A2.crystal growth;

1. Introduction

The ternary semiconductors with the general formula $A^I B^{III} C_2^{VI}$ are widely studied due to their promising potential applications [1-3]. Among these compounds, silver thiogallate ($AgGaS_2$) is known for a long time for its outstanding nonlinear optical properties. It has large nonlinear optical (NLO) coefficient (d_{36} = 18 pm/V), sufficient birefringence (n_e-$n_o \approx 0.05$), wide IR

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