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Chemical synthesis and crystal growth of AgGaGeS_4 , a material for mid-IR nonlinear laser applications

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Mid infrared laser sources have attracted a particularly attention due to their potential applications in different fields such as infrared counter-measures and remote chemical sensing (e.g: LIDAR) [1]. Nowadays, there is a strong need for nonlinear materials able to convert efficiently a 1.064 μm wavelength (Nd:YAG) to wavelengths higher than 4 μm . Consequently, we are particularly interested in the AgGaGeS_4 compound (AGGS) which is a promising nonlinear material for mid-IR applications [2,3]. In the present work, the different steps of this material's processing will be described. The chemical synthesis of polycrystals and the single crystal growth process will be presented. Otherwise, we will discuss about the key parameters related to this material preparation and elaboration. Particularly, we will focus on compounds volatility which can induce stoichiometry deviation and reduce the quality of obtained single crystals. Currently, a 28 mm diameter and 70 mm length single crystals have been grown by the Bridgman-Stockbarger method, a cut and polished sample of AGGS crystal is presented on Fig 1. The crystal has good homogeneity and an absorption coefficient as low as 0.04 cm^{-1} in the 0.5-11.5 μm range which make it usable in nonlinear optical devices. Difference frequency generation (DFG) experiments are currently in progress to characterize the nonlinear properties of the material.

Fig. 1 Photograph of cut and polished AgGaGeS_4 single crystal.

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