MICROSTRUCTURE AND CHEMICAL COMPOSITION OF CENTAUR CRYSTAL GaSe:$AgGaS_2$

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GaSe crystal lattice is capable to incorporate different doping elements at high content with noticeable modification of physical properties responsible for frequency conversion efficiency. Besides doping with element admixtures, such complex doping agent as $AgGaSe_2$ was proposed [1]. The GaSe crystals doped with 10.4 mass% $AgGaSe_2$ compound were characterized by increased nonlinear coefficient of 75 pm/V. Present study is aimed at crystal growth of $(Ga_2Se_2)_{1-x}(AgGaS_2)_x$, x = 0.1, solid solution and an observation of grown crystal with SEM, TEM and determination of real chemical composition.

Doped GaSe crystals were grown by conventional Bridgman technique in evacuated quartz ampoule of 18 mm in diameter. The starting materials for GaSe synthesis were 6N Ga and 6N Se. Stoichiometric $AgGaS_2$ were added into a charge used for crystal growth. The samples were cleaved from grown ingots parallel to the c-plane and were used for measurements without any additional treatment or polishing. Micromorphology was evaluated by scanning electron microscopy (SEM). Element composition was estimated with electron probe microanalysis (EPMA). Composition determination was provided with atomic-absorption spectrometry and inductively coupled plasma optical emission spectrometry. Structural properties of doped crystals were observed with transmission electron microscopy (TEM).

Sample surface was formed by flat terraces with sharp edges that is typical for GaSe surface. EPMA analysis reveals clear signal of sulphur and no signal related to silver. Determination of chemical composition of GaSe:$AgGaS_2$ solid solution shows stable sulphur content at the level 2.19±0.05 wt%. Contrary to that, the silver content fluctuates drastically from sample to sample within the range 0.06-1.6 wt%. Generally, it can be concluded that sulphur is homogeneously distributed over the crystal bulk. As to silver, this admixture seems to be concentrated into local precipitates. Only GaSe-type crystalline phase was detected by TEM observation. As it may be supposed, silver-bearing precipitates are either amorphous or these were not opened by sample preparation. As it is found by complex observation, silver atoms were not incorporated into GaSe lattice and were segregated with formation of amorphous inclusions. Generally, the grown crystal is a GaSe:S solid solution.

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