Growth and Characterization of High Quality Single Crystals of Nonlinear Optical L-Arginine Sulfate and its Dihydrate

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The sulfates of amino-acids have been widely studied [1-3], particularly TGS crystal [2], which is used in various fields as an infrared receiver sensor, but the L-arginine sulfate hasn't been obtained. Monaco et al. mentioned that salt can't be obtained from L-Arg+H_2SO_4+H_2O system and formed a viscous solution [4]. Sukiasyan et al. investigated the reaction of L-arginine with sulfuric acid in more detail and obtained five compounds. The thermal properties and vibrational spectra were studied [5].

Fig. 1. The crystal of (L-Arg^{2+})·(SO_4^{2-})

The subjects of the present study are nonlinear optical crystals: (L-Arg^{2+})·(SO_4^{2-})·2H_2O (I) and (L-Arg^{2+})·(SO_4^{2-}) (II). Needle-like (I) and bulky (II) crystals were obtained from aqueous solutions containing stoichiometric molar ratios of L-arginine and sulfuric acid at the temperature range of 0-15°C and above 18°C, respectively. The crystal and molecular structure of (I) and (II) were determined by X-ray diffraction method. These crystallize in the monoclinic ($P2_1$) and orthorhombic ($P2_12_12$) systems, respectively. Unit cell parameters: a=8.0895(16)Å, b=7.0417(14)Å, c=12.146(2)Å, α=γ=90°, β=91.07(3)°, Z=2, Dc=1.480g/cm^3 for (I) and a=10.5118(2)Å, b=21.1861(5)Å, c=10.1165(2)Å, α=β=γ=90°, Z=8, Dc=1.605g/cm^3 for (II). Asymmetric part of the unit cells of (I) and (II) contain two crystallographically independent L-argininium (2+) cations and two sulfate anions, (I) also has two water molecules. The conditions for crystal growth were studied and high quality crystal (Fig. 1) was grown by SER method. This method was developed and named by the authors. Solubility was determined by a method of sequential dissolution of decreasing amounts at a given temperature. The grown crystals were subjected to etching and microhardness studies. The thermal properties, vibrational spectra, UV-Vis transmittance spectrum and second harmonic generation activity were studied. In the crystal at certain orientations, phase-matched second harmonic generation was observed.

References

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