$CuGaSe_2$ 단결정 박막 성장과 광전류특성

Growth and Photocurrent Properties of $CuGaSe_2$ Single Crystal

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The stochiometric mixture of evaporating materials for the $CuGaSe_2$ single crystal thin films were prepared from horizontal furnace. Using extrapolation method of X-ray diffraction patterns for the polycrystal $CuGaSe_2$, it was found tetragonal structure whose lattice constant a_0 and c_0 were 5.615Å and 11.025Å, respectively. To obtains the single crystal thin films, $CuGaSe_2$ mixed crystal was deposited on throughly etched GaAs(100) by the Hot Wall Epitaxy(HWE) system. The source and substrate temperature were 610℃ and 450℃ respectively, and the growth rate of the single crystal thin films was about 0.5㎛/h. The crystalline structure of single crystal thin films was investigated by the double crystal X-ray diffraction(DCXD). Hall effect on this sample was measured by the method of van der pauw and studied on carrier density and mobility depending on temperature. From Hall data, the mobility was likely to be decreased by pizoelectric scattering in the temperature range 30K to 150K and by polar optical scattering in the temperature range 150K to 293K. The optical energy gaps were found to be 1.68eV for $CuGaSe_2$ single crystal thin films at room temperature. The temperature dependence of the photocurrent peak energy is well explained by the Varshni equation then the constants in the Varshni equation are given by $\alpha=9.615\times 10^{4}$eV/K, and $\beta=335$K. From the photocurrent spectra by illumination of polarized light of the $CuGaSe_2$ single crystal thin films. We have found that values of spin orbit coupling ΔSo and crystal field splitting ΔCr was 0.0900eV and 0.2498eV, respectively. From the PL spectra at 20K, the peaks corresponding to free bound excitons and D-A pair and a broad emission band due to SA is identified. The binding energy of the free excitons are determined to be 0.0626eV and the dissipation energy of the acceptor-bound exciton and donor-bound exciton to be 0.0352eV, 0.0932eV, respectively.

포스터발표