Properties of Photocurrent and Growth of CuInSe₂ single crystal thin film

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The stochiometric mix of evaporating materials for the CuInSe₂ single crystal thin films was prepared from horizontal furnace. To obtain the single crystal thin films, CuInSe₂ mixed crystal was deposited on thoroughly etched semi-insulating GaAs(100) substrate by the Hot Wall Epitaxy (HWE) system. The source and substrate temperature were 620 °C and 410 °C, respectively. The crystalline structure of single crystal thin films was investigated by the photoluminescence and double crystal X-ray diffraction (DCXD). The carrier density and mobility of CuInSe₂ single crystal thin films measured from Hall effect by van der Pauw method are 9.62×10¹⁶ cm⁻³, 296 cm²/V·s at 293 K, respectively. From the photocurrent spectrum by illumination of perpendicular light on the c-axis of the CuInSe₂ single crystal thin film, we have found that the values of spin orbit splitting ΔSo and the crystal field splitting ΔCr were 6.1 meV and 175.2 meV at 10 K, respectively. From the photoluminescence measurement on CuInSe₂ single crystal thin film, we observed free excitation (Ex) existing only high quality crystal and neutral bound exciton (D⁰.X) having very strong peak intensity. Then, the full-width-at-half-maximum (FWHM) and binding energy of neutral donor bound excitation were 7 meV and 5.9 meV, respectively. By Haynes rule, an activation energy of impurity was 59 meV.