MS18-P11 | Band Gap Depth Profile of $Cu(In_{1-x}Ga_x)Se_2$ Absorbing Layer in Thin-Film Solar Cell by Glancing Incidence X-Ray Diffraction

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Absorbing materials ofthe thin-film solar cells need a direct band gap and a very high absorption coefficient for visible light because the solar cells convert sunlight into electricity by exciting electrons in the absorbing layer using the photons of light from the sun. Hence, $Cu(In,Ga)Se_2$(CIGS) has attracted attention as one of the absorbing materials due to its a direct band gap with a high absorption coefficient. One of the main factors that determine the performance of the solar cells is the band gap of the absorbing material. The present work investigates in-depth lattice parameters of the CIGS absorbing layer using a glancing incidence X-ray diffraction (GIXRD) because the band gaps of materials depend on the lattice parameters. As the glancing incident angle increases, the a and c lattice parameters changed from 5.7776(3) to 5.6905(2) Å and 11.3917(3) to 11.2114(2) Å, respectively. These variations were due to the compositional gradients of the CIGS absorbing layer. The behavior of the unit-cell volume variations was similar to the compositional depth profiles of In or Ga using energy dispersive X-ray analysis. The band gap of the CIGS absorbing layer based on the in-depth analysis of the lattice parameters refined using GIXRD data was in the range of 1.222 to 1.532 eV. This approach, estimating the relative contents of In or Ga occupied in the same lattice sitesfrom the refinement of the lattice parameters with GIXRD provides the band gap depth profile of the absorbing layer under the unit-cell volume follows Vegard's law.