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Optical applications of wide-band-gap gallium oxide

T. Oshima[1]
[1]Tokyo Institute of Technology, Department of Applied Chemistry, Tokyo, Japan

Ga_2O_3 have been attracting much attention as a wide-band-gap semiconductor owing to a large band-gap of 4.8 eV and the availability of high-quality and large-sized single crystals, which are advantageous over conventional wide-band-gap semiconductors. This presentation focuses on optical applications using Ga_2O_3 single crystals: photodetectors and photoelectrodes, both of which show interesting and promising properties[1,2]. As for photodetectors, a PEDOT-PSS Schottky and In ohmic contacts were prepared on front and back surfaces of a n-type Ga_2O_3 single crystal plate, respectively, to fabricate a photovoltaic detector. The detector operated at zero bias (V = 0 V) exhibited high responsivities in the solar-blind region (< 280 nm). Incident photon to current conversion efficiency (IPCE) was as high as 21% at 240 nm and a 240-to-300 nm rejection ratio was as large as 10^4, indicating that the detector can be applicable for flame sensing. In fact, the detector successfully detected a flame by distinguishing several nW/cm^2 weak solar-blind light from a flame under a strong fluorescent lamp illumination without using visible-cut filters. As for photoelectrodes, an n-type Ga_2O_3 single crystal plate with In ohmic contact on the back side was used for characterization. From impedance analysis, the conduction and valence band-edges in aqueous solutions were found to be 1.1 V higher and 2.5 V lower than the H^+/H_2 and O_2/H_2O redox potentials, respectively. These potential differences, or overpotentials for water splitting, are large enough for photolysis of water. When the photoelectrode was excited by photons, H_2 and O_2 gases evolved from a counter Pt electrode and the photoelectrode, respectively. The highest IPCE of 36% was obtained at 240 nm. Stoichiometric water splitting was demonstrated at V = 1V without using co-catalysts. These results encourage the notion of Ga_2O_3 optical applications and also contribute for developing Ga_2O_3 semiconductor studies.

[1] *T. Oshima, T. Okuno, N. Arai et al., Jpn. J. Appl. Phys., 2009, 48, 011605,* ***[2]*** *T. Oshima, K. Kaminaga, H. Mashiko et al., Jpn. J. Appl. Phys., 2013, 52, 111102*

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