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高倍集光下の多重量子井戸太陽電池におけるキャリア輸送評価

Evaluation of Carrier Transport in Multiple Quantum Well Solar Cells under Concentrated Light Illumination

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The carrier transport in Multiple Quantum Wells (MQWs) solar cells was investigated by analyzing Carrier Collection Efficiency (CCE) of GaAs reference and InGaAs/GaAs/GaAsP MQW cells with 2-nm and 6-nm thick-barrier under high sunlight concentration. The CCE was estimated by comparing I-V curves measured at 1 sun and at 358 suns irradiation. Net photocurrent which is the difference between photocurrent and dark current was normalized by the saturation value at a sufficiently-high reverse bias. The saturated current density (J_{sat}) of 2 and 6-nm barrier cells were higher than of GaAs reference cell at 1 sun owing to the additional absorption in the MQWs, but the 6-nm barrier cell showed lower J_{sat} than GaAs reference cell and clearly degraded CCE at high concentration. The degradation of CCE at high concentration for 6-nm barrier cell could be described by the carrier screening effect caused by accumulated carriers in quantum wells. On the other hand, almost no degradation in CCE for the 2-nm barrier cell could indicate that the screening effect was eliminated owing to rapid carrier transport by tunneling preventing carrier accumulation in the wells. Therefore, enhanced carrier collection by tunneling seems mandatory for the high-efficiency operation of MQW cells under high sunlight concentration. In this research, I-V characteristics and CCE of MQWs solar cells have been evaluated for investigating the carrier transport under high concentrated illumination.

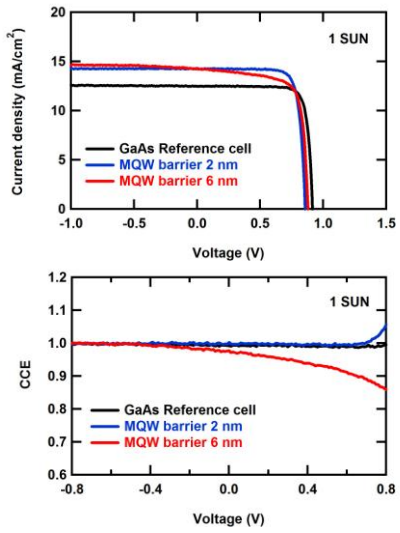

Fig.1 I-V curves and CCE at 1 sun

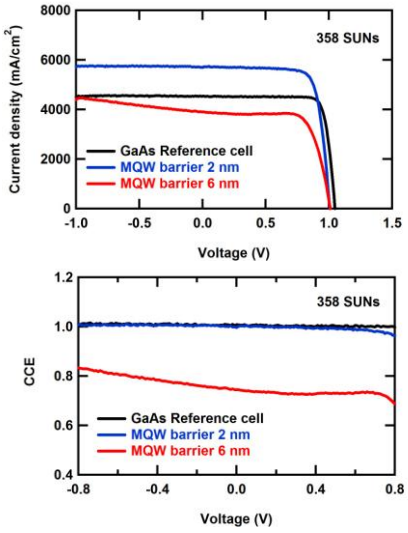

Fig.2 I-V curves and CCE at 358 suns irradiation