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The international debate on Optimizing the structure of quantum dot Intermediate-band solar cells

Yoshitaka Okada
The University of Tokyo, Japan

Significant efforts have been devoted in order to demonstrate operation of quantum dot intermediate band solar cells (QD-IBSCs) [1]. The challenge for QD-IBSCs is to establish methods to fabricate high-density QDs arrays of low defect density with long carrier lifetimes. The areal density of QDs has direct influence on the generation and recombination processes via IB states since the total density of states of IB (NIB) is linked to the areal density Nareal as NIB = Nareal × Nstacks / W, where Nstacks is the number of QD layer stacks and W is the width QD region, respectively. For this, we have shown that strain-compensated growth improves the QDs quality and characteristics of InAs/GaAs QDSCs with Nstacks up to 100 in self-organized heteroepitaxy by MBE. However, the average QD size prepared by such dry methods is still large and Nareal is low, typically limited to the range of 15-30 nm and 1011- 1012 cm-2, respectively. Furthermore, strain-induced bandgap widening of InAs QDs reduces the offset between the barriers, which results in an increased thermal escape of carriers out of QDs thereby reducing photocurrent production by 2-step photoabsorption (TSPA). In this work, optimization of QD-IBSC structure is studied for which PbS colloidal QDs of 4 nm in size were densely dispersed in a bulk CH3NH3PbBr3 perovskite matrix with a high energy bandgap of 2.4eV [2]. We focus on the TSPA characterization performed at room temperature.

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