Current status on the development of silicon quantum dot solar cell

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Si quantum dot (QD) solar cell is a third generation solar cell with high conversion efficiency and low fabrication cost. Band gap energy of the self-assembled Si QD layer can be engineered by varying the size of Si QDs by quantum confinement effect. As a result, the emission and absorption of visible light by Si QD layer can be a great advantage to enhance the power conversion efficiency.

One of the common methods to fabricate Si QD layer is alternating deposition of silicon dioxide and silicon rich oxide (SRO). Si QDs distributed in a SiO_2 matrix are formed by phase separation of the SiO_2/SRO multilayer film by annealing at high temperature (1100℃). The photovoltaic property of the Si QD layer was optimized by in-situ x-ray photo electron spectroscopy (XPS) for the control of stoichiometry of the SRO layers, Secondary Ion Mass Spectrometry (SIMS) for the analysis of doping concentration and Photoluminescence (PL) for the measurement of the bandgap energy of the Si QD layers.

In this presentation, the status of the development of Si quantum dot solar cell in KRISS will be presented. The photovoltaic properties of Si QD solar cells depending on size, density, and doping concentrations of Si QDs embedded in SiO_2 matrix will be discussed. Furthermore, the effect of fabrication processes of Si QD solar cell, such as, surface passivation, metallization, and back surface field on photovoltaic properties will be also introduced.