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Dielectric micro-resonator arrays for optical coupling to solar cells DONGHEON HA, CHEN GONG, MARINA S. LEITE, JEREMY N. MUNDAY, Univ of Maryland-College Park, MUNDAY LAB TEAM, LEITE LAB COLLABORATION — Reflection occurs at the interface of a semiconductor and air as a result of the index of refraction contrast between the two media. In order to increase the coupling efficiency of free-space light to the modes of a solar cell, single- or double-layer dielectric thin-film anti-reflection coatings (ARC) are typically used. As an alternative approach, we introduce a new anti-reflection coating based on silicon dioxide (SiO_2) nanospheres that enable high absorption and low-cost photovoltaic devices through a combination of effects including scattering, thin-film interference, and sphere-sphere coupling. From experiments and Finite Difference Time Domain (FDTD) simulations, we show that there is ˜15-20% enhancement in light absorption within the substrate (Si), which ultimately leads to increased spectral current density. We also show the enhancement of the optoelectronic properties via photoresponse measurement on multi-crystalline Si solar cells with SiO_2 nanosphere arrays on top. Because the layer can be made with an easy, inexpensive, and scalable process, this proposed ARC is an excellent candidate for substituting conventional ARC technologies relying on complicated, high temperature and expensive processes.

Dongheon Ha
Univ of Maryland-College Park

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