Templated Nanostructures for Solar Cells

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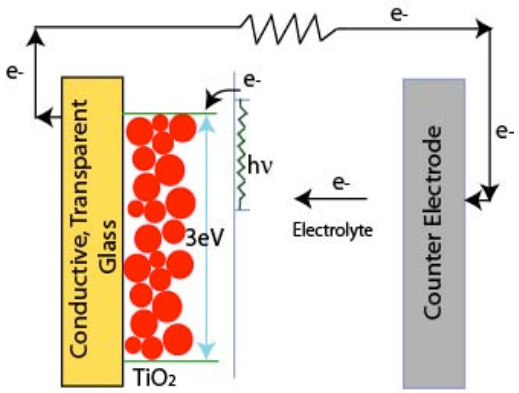
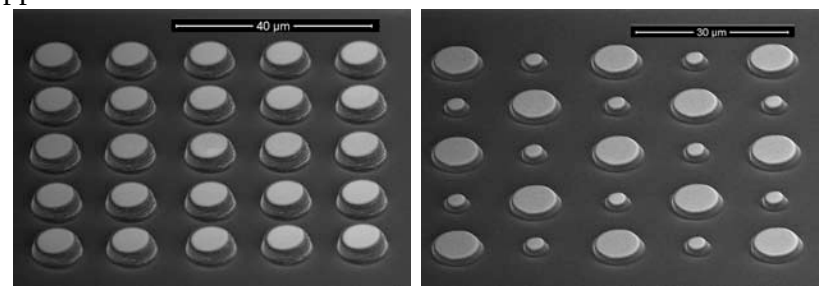
The challenge in converting sunlight to electricity is how to dramatically increase the solar to electrical conversion efficiency. Solar cells have long been deemed as the most preferred solution if the conversion efficiency can be properly improved. To enable solar electricity from photovoltaics to be competitive with, or cheaper than, present fossil fuel electricity requires devices that operate above the existing performance limit of energy conversion efficiency of 31% calculated for single-junction cells.[1] New structures need to be developed to efficiently absorb sunlight and harness the full spectrum of wavelengths in the solar radiation. Developing high-efficiency and low-cost photovoltaic structures that can reach or exceed the predicted efficiency limits presents challenging but exciting opportunities in solar cell research.

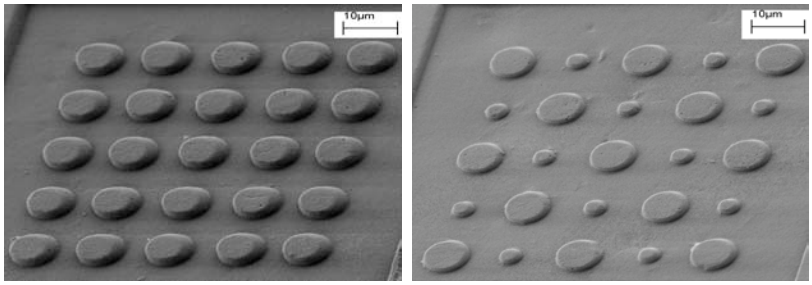


Dye-sensitized TiO_2 solar cell illustration.

Nanoparticle size decrease has opened a whole new field for unique photovoltaic cell material forming. Our study is focused on making molds with nano- to micron-size feature arrays, studying nanoparticle colloidal suspension, and cast forming of surface templated materials. Polymeric molds with nano- and micron-size feature arrays are made using focused ion beam templated mold core. Nanoparticle suspensions are evaluated based on nanoparticle interaction energy and suspension flowability. Templated surface feature transfer ability is compared for different molds under ambient and freeze drying conditions. This work provides a new approach for surface templating of nanoparticle based photovoltaic solar cell electrode.



Island arrays produced by focused ion beam on silicon wafer: (a) uniform diameter islands, (b) alternating diameter islands.



Different features made by templating: (a) uniform diameter islands, (b) alternating diameter islands.

1. W. Shockley, H. J. Queisser, "Detailed Balance Limit of Efficiency of p-n Junction Solar Cells," J. Appl. Phys., 32, 510-519, 1961.