Experimental and Simulation Visualization of High-Performance Hybrid Solar Cells

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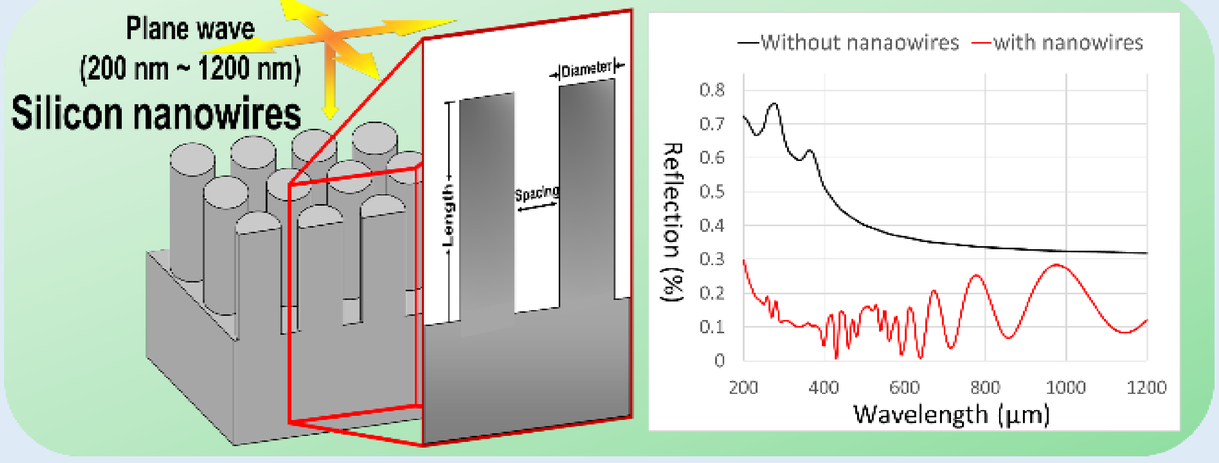
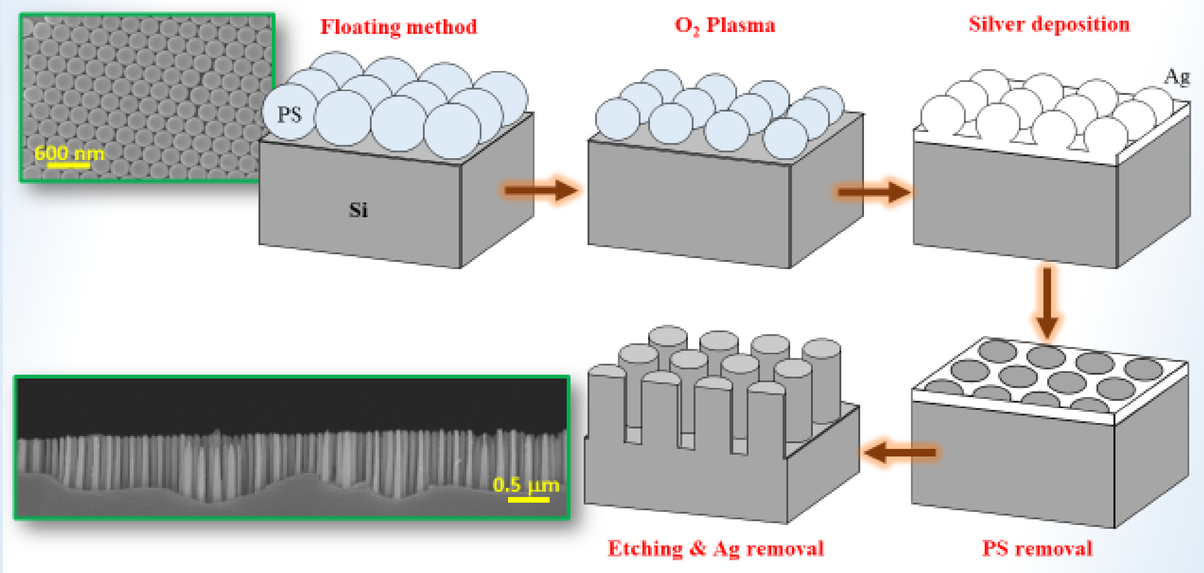
We investigated the hybrid solar cells with conversion efficiency higher than 11% through both experimental and simulation visualizations. A low cost nanosphere lithographic method in combination with wet chemical etching technique were performed to realize the controlled formation of silicon nanowire arrays with precisely defined dimensions. Designs of nanostructures were modeled with FDTD analysis, which enabled us to optimize the light-trapping effects of hybrid solar cells. The results along with design strategy were anticipated to be highly potential for the low-cost, simplified and reliable high-performance solar cells.

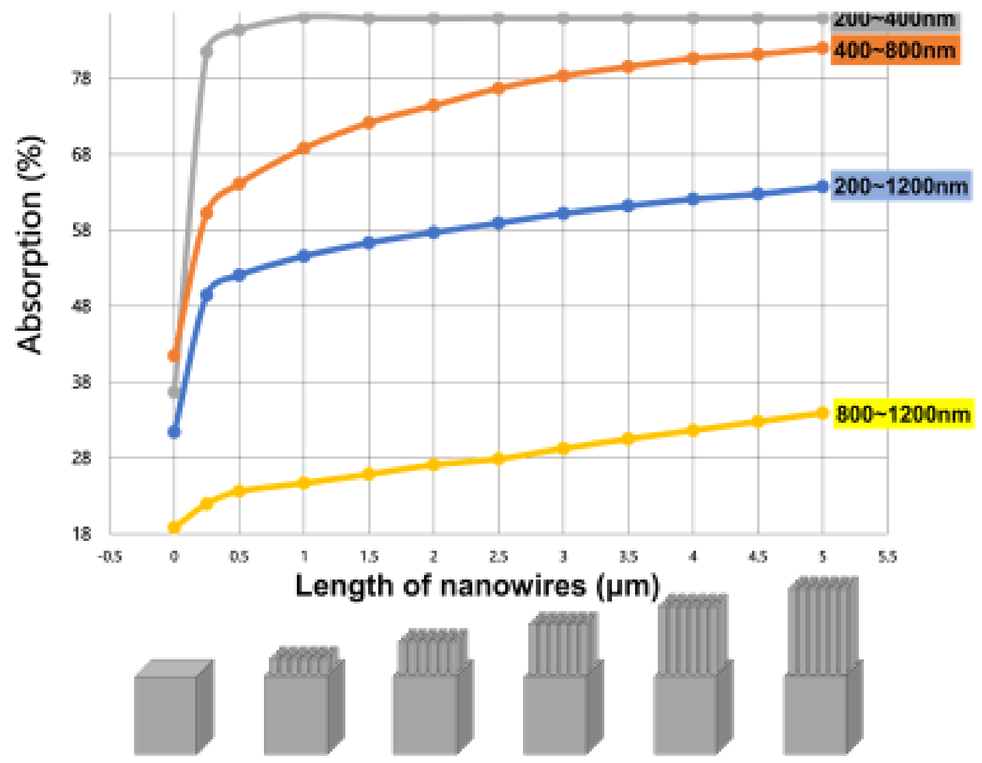
Keywords: Light reflectivity, light trapping effect, FDTD simulation, efficiency improvement .



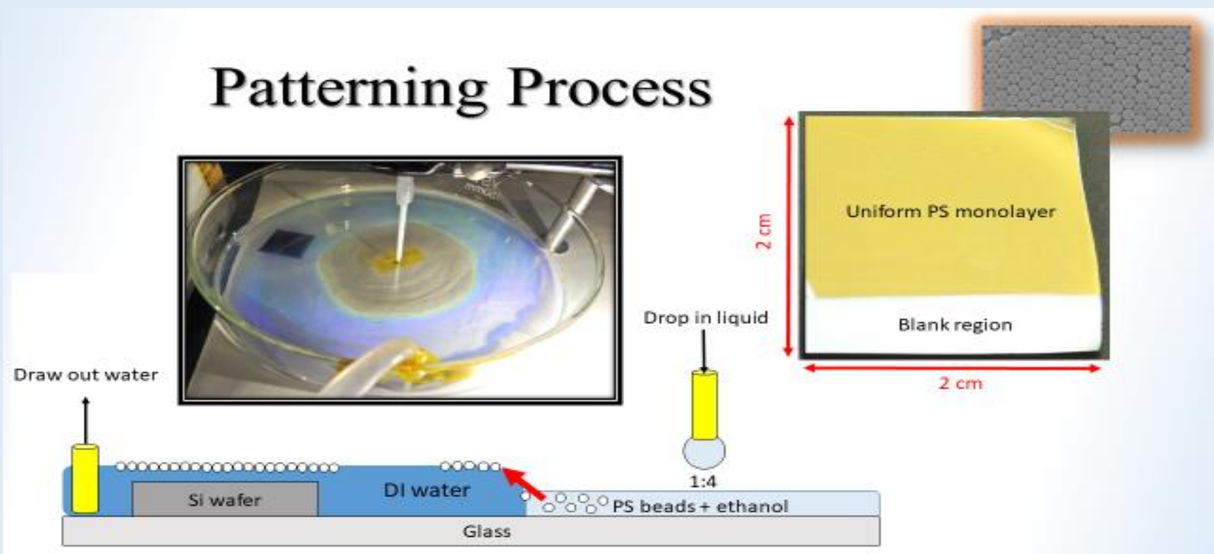
Regularly Aligned Silicon Nanowire Arrays



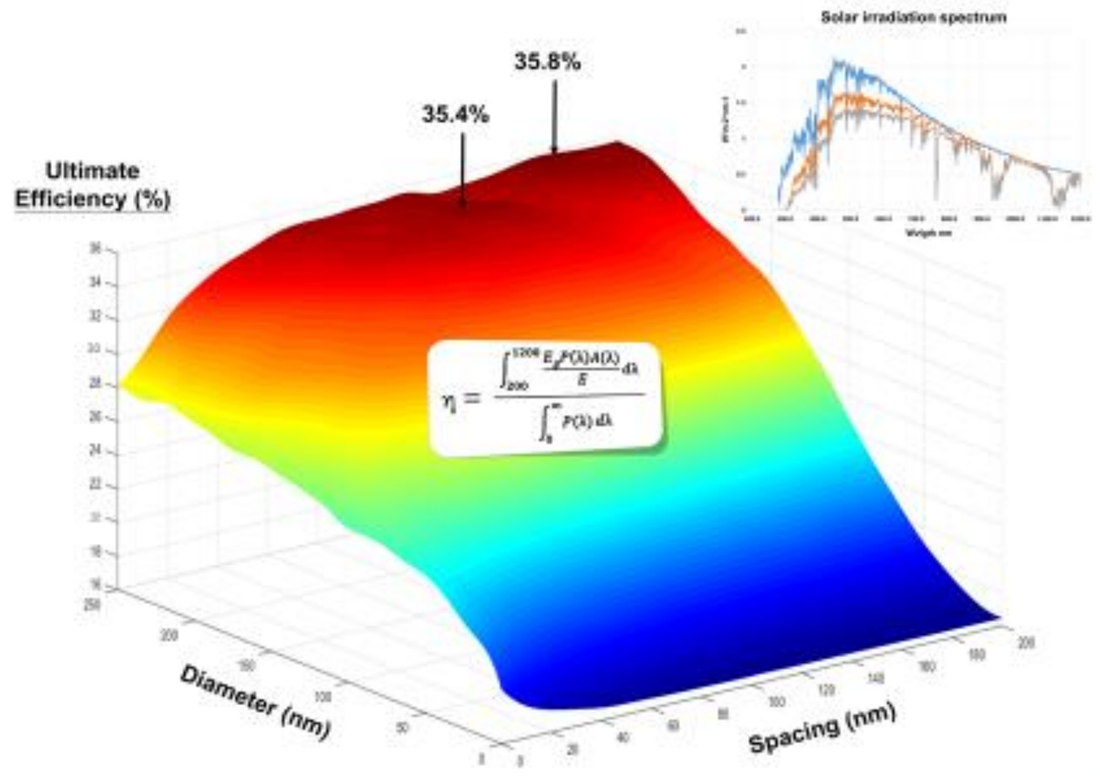
Optimizing the Length-Dependent Absorption



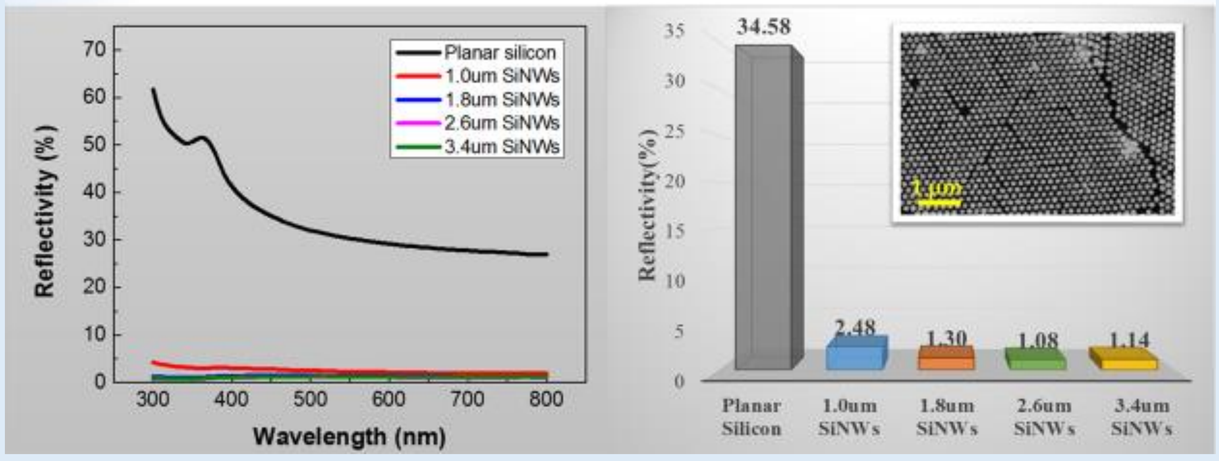
Patterning Process



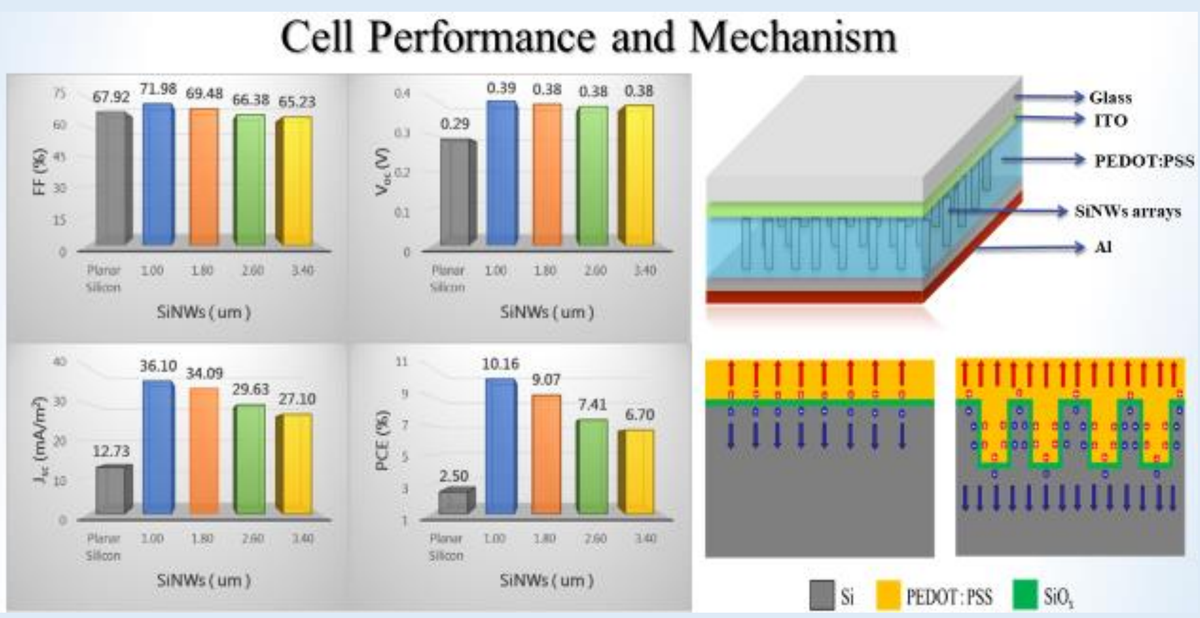
Ultimate Efficiency of Solar Cells



Reflectivity Measurements



Cell Performance and Mechanism



Conclusion : The enhanced light absorption of silicon nanowire arrays can be effectively observed under wide wavelengths of incident light by tuning their diameters and spacing modeled by FDTD simulation. As a consequence, the ultimate efficiency of nanowire-based solar cells can reach 35.8% based on the optimized structural designs of nanowire structures, which is quite promising for the development of next-generation photovoltaic cells with superior optoelectronic properties.

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