



ENI AWARD 2012

Renewable and Non-conventional Energy Prize

**Harry A. Atwater
Albert Polman**

High-efficiency solar cells based on nanophotonic design

Research description

Photovoltaics, the conversion of sunlight to electricity, is a clean, renewable and robust technology that enables the generation of electrical power at a very large scale. It has the potential to make a significant contribution to the world's energy supply in the next generation. Harry Atwater and Albert Polman have developed radically new solar cell designs that enable both a higher photovoltaic conversion efficiency and reduced manufacturing costs.

Atwater and Polman's research addressed the two key problems in photovoltaic technology: 1) conventional solar cells do not convert all light from the sun into electricity, and 2) solar cells are relatively expensive to manufacture because of high materials costs. They discovered that these problems can be partly solved by proper "*light management*": achieving better control over the capturing and absorption of sunlight in the solar cell. They demonstrated that by integrating precisely designed metallic or dielectric nanostructures into the solar cell, the different colors of light from the sun are more efficiently absorbed, so that the conversion efficiency from sunlight to electricity increases. In addition, the enhanced light absorption enables the thickness of solar cells to be strongly reduced, so that they can be manufactured at much lower costs. This is particularly interesting for solar cells based on materials that are scarce in the earth's crust. Their nano-solar cell technology is scalable to ultra-high volumes and may help speed up the development of photovoltaics to the tera-Watt scale.

Atwater and Polman and their research teams have demonstrated ultra-thin silicon solar cells on glass, world-record efficiency thin-film GaAs solar cells, and entirely novel designs based on silicon microwires and nanoparticles. Their light management approaches to solar cell design are applicable to other solar cell technologies as well, including thin-film CuInSe₂, CdTe, polymer, organic and dye-sensitized solar cells. Atwater and Polman have openly proposed many novel solar cell designs in scientific publications, aiming to stimulate the photovoltaics community at large to reach higher efficiency solar cells at further reduced costs.