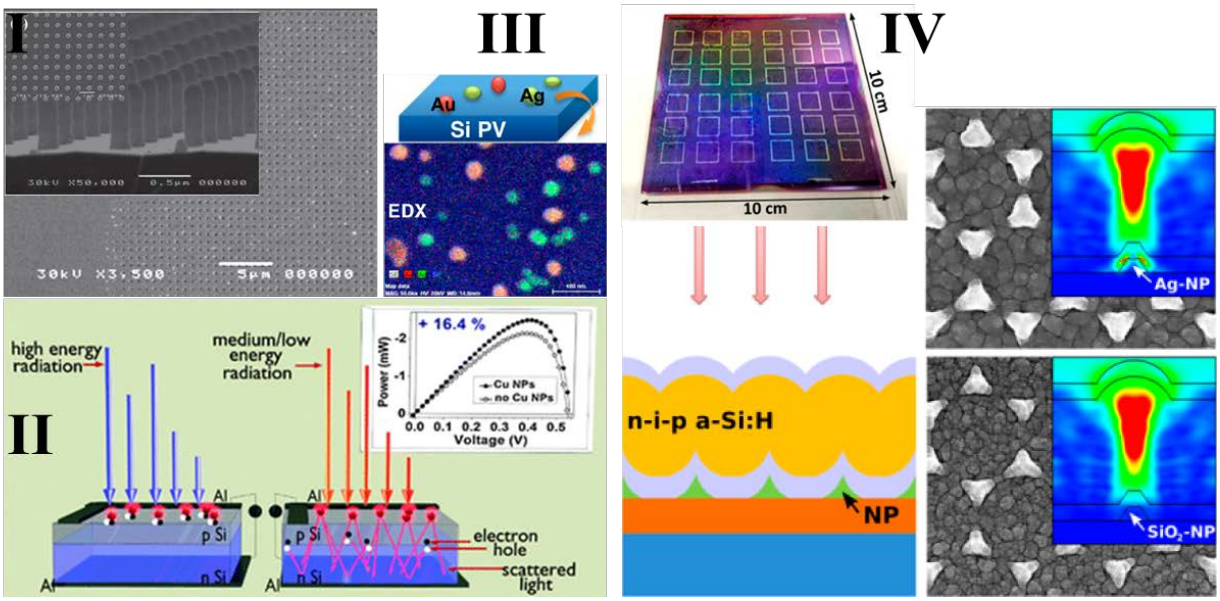
Project Title:

Plasmonic nanomaterial enhanced light trapping in silicon solar cells

Research project:

Plasmonic light trapping structures can significantly improve the efficiency of solar cells. Surface plasmon is the collective electron oscillations phenomenon near a metal surface, when the incidence light is in resonance with electron oscillations; the electric field near the metallic surface is greatly increased. This phenomenon allows various ways to increasing the light path length inside a thin film solar cell absorber layer. Large-area well organized nanohole patterned plasmonic electrode (I) for thin-film organic solar cell application was demonstrated.[1] The different plasmonic materials, such as copper (II),[2] silver, and gold nanoparticles (III),[3] as an antireflective coating to improve the existing silicon solar cell was optimized. In addition, we also fabricated the identically shaped plasmonic metallic (Ag) and photonic nonmetallic (SiO_2) nanoparticles inside amorphous silicon solar cells and compared the enhanced mechanisms experimentally and computationally (IV).[4]



Publication:

(1) Menezes, J. W.; Ferreira, J.; Santos, M. J. L.; Cescato, L.; Brolo, A. G. Large-Area Fabrication of Periodic Arrays of Nanoholes in Metal Films and Their Application in Biosensing and Plasmonic-Enhanced Photovoltaics. *Adv. Funct. Mater.* **2010,** *20*, 3918-3924.
(2) de Souza, M. L.; Corio, P.; Brolo, A. G. Cu Nanoparticles Enable Plasmonic-Improved Silicon Photovoltaic Devices. *PCCP* **2012,** *14*, 15722-15728.
(3) Wang, P. H.; Millard, M.; Brolo, A. G. Optimizing Plasmonic Silicon Photovoltaics with Ag and Au Nanoparticle Mixtures. *J. Phys. Chem. C* **2014,** *118*, 5889-5895.

(4) Theuring, M.; Wang, P. H.; Vehse, M.; Steenhoff, V.; von Maydell, K.; Agert, C.; Brolo, A. G. Comparison of Ag and Sio2 Nanoparticles for Light Trapping Applications in Silicon Thin Film Solar Cells. *J. Phys. Chem. lett.* **2014**, 3302-3306.