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Tenkých vrstev a nanostruktur

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TÉMA

Plasmonic metal nanoparticles for thin film solar cells

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Over the past few years metal nanoparticles (NPs) have attracted considerable interest due to their ability to strongly enhance electromagnetic fields and their potential applications in thin film photovoltaics. When the size of a noble-metal particle is reduced to the few nanometer range, it can sustain Localized Surface Plasmon Resonances (LSPR), collective oscillations of free-electrons resulting from the interaction with the incident light, which dramatically influence the NPs optical properties. The LSPR strongly depend on the material of the NPs, their geometrical parameters (size, shape) and the surrounding medium. Thus, metal nanoparticles should be properly designed in order to reduce as much as possible the parasitic absorption inside their material while allowing high light scattering.

For applications in low-cost, high-efficiency thin film solar cells, the NPs should be inserted in the cell transparent conductive oxide (TCO) layer which separates the rear mirror from the Si layers. In this way, a plasmonic back reflector (PBR), composed of a flat silver mirror and a layer of Al-doped ZnO (AZO) with embedded metallic NPs, is constructed. Such PBR can redirect the light at angles away from the incidence direction and thereby increase its path length in the cell.

Two different plasmonic nanostructures will be presented and their optical and structural properties discussed:

- self-assembled Ag NPs fabricated by the solid-state dewetting process (deposition of thin metal film followed by thermal treatment)
- colloidal Au NPs patterned with a self-assembly wet-coating method.

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