

Periodic plasmonic nanostructures for enhanced light absorption in silicon

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Abstract

Plasmonic nanostructures have been widely studied for enhancing the absorption of light in different solar cell structures [1]. Scattering due to plasmon resonances in the metallic nanostructures or nanoparticles can reduce reflection leading to antireflection effect and significant improvements in the transmission of light into the device. Metallic nanostructures supporting surface plasmons can also confine and guide incident light into sub-wavelength thickness absorber layers, as well as couple it into the waveguide modes, which provides high potential for a significant further improvement in the light absorption in thin active layers in various devices. With appropriate combinations of the different physical phenomena the incoupling ability can be enhanced in the selected wavelength ranges and in others suppressed if wished. In practice, the spectral response of the device can be tuned by adjusting of the plasmonic structures and modifying the device layer geometrics and materials.

In the present work, the influence of plasmonic nanostructures on the light absorption in thin film test devices is investigated by computation methods. It is shown that in the specific spectral regions absorption enhancements as high as ten-fold, or even forty-fold, are easily obtained. Selected aspects related to the application of periodic plasmonics nanostructures for light coupling into thin film silicon are highlighted and the physical phenomena responsible for the effect discussed.

References

[1] P. Spinelli, V. E. Ferry, J. van de Groep, M. van Lare, M.A. Verschuuren, R.E.I Schropp, H.A. Atwater and A. Polman, *J. Optics* **14** (2012) 024002.

Figures

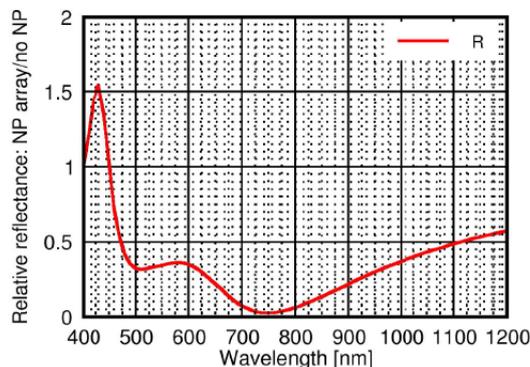


Figure 1. An example of the influence of an array of plasmonic nanoparticles (NP) on the reflectance of a silicon sample: The relative reflectance of the sample with and without nanoparticles is shown.