Mm^2 size arrays of metal nano-particles for solar cell applications fabricated by Electron Beam Lithography (EBL)

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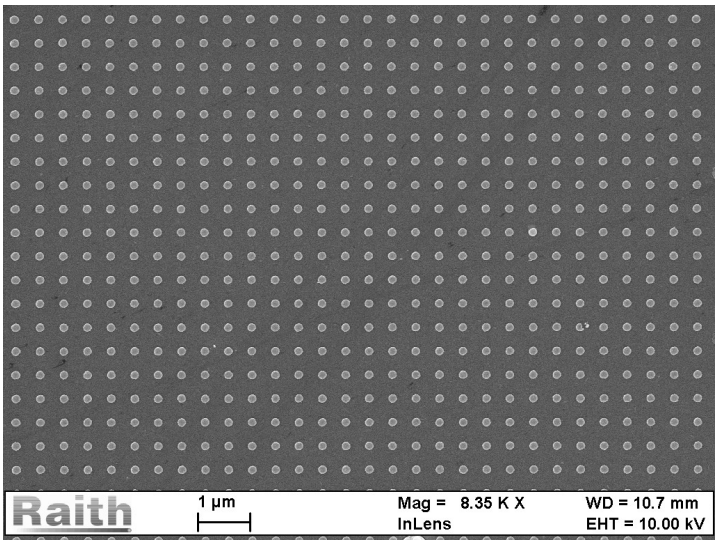
Metal in bulk has its metallic reflective properties due to the, loosely bound, valence electrons shared by the metal ions. When moving into the nano-regime, the optical properties of metals change significantly, and if the bulk metal is split into particles smaller than the wavelength of the incoming light, the electric field of the incoming wave will move these valence electrons in a collective motion, and thus polarise the whole particle. This effect is known as surface plasmon resonance of metal nano-particles. The excitation of plasmons in the nano-particles lead to absorption of frequencies of the incoming electro-magnetic wave corresponding to the resonance frequency of the particle, which is strongly dependent on the size of the nano-particle.

This size-dependent tunable absorption spectra of nano-particles is of particular interest in solar cell applications, and for sensing devices and has been extensively researched the last decades. With new tools and instruments high dimension and positioning control is available and the properties can be tested in detail, and precise models for the properties can be developed. For many applications it is important to be able to make large scale structures which is a particular technical challenge.

We have fabricated two dimensional arrays of several square millimetres with periodically spaced metal nano-particles using Electron Beam Lithography (EBL). The nano-particles have been tuned and calibrated in all three dimensions with high precision. The particle array spacing can be chosen to match the required specifications. In the fabrication we have experimented with the use of the so-called defocused beam set-up[1] for improving the edge roughness and the shape repeatability when patterning.



1 C. David and D. Hambach / Microelectronic Engineering 46 (1999) 219-222