Periodic arrangements of Si quasi-spheres

Magdalena Solà, Ramón Alcubilla, Moisés Garín*

Departament d'Enginyeria Electrònica, Universitat Politècnica de Catalunya,
c/ Jordi Girona 1–3, Barcelona, 08034, Spain.
* moises.garin@upc.edu

Abstract

Silicon photonics has gained increasing interest in recent years as it promises high performance, cost-effective integrated optical devices. The advent of Si fabrication techniques at the micro and nano-scales, in conjunction with the interesting optical properties of this material, such as its high refractive index, has enabled the development of new methods of light confinement, which allows them to behave as excellent resonators with ultra-high quality factors.

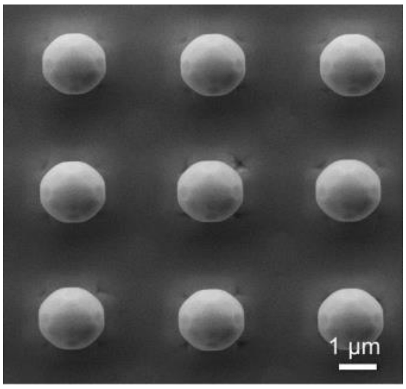
In particular, Si microspheres offer a great potential for sunlight harvesting applications [1,2] since they can exhibit absorption cross sections higher than one in the visible, and boost absorption at the bandgap edge at wavelengths above 1200 nm. Indeed, a PV device was recently reported in single µc-Si microspheres, with diameters in the range 1–3 µm, showing experimentally the band-to-band resonant absorption enhancement in the NIR frequencies up to λ=1600 nm.

There are already a few methods that allow to produce silicon microspheres with sizes in the micrometer range. One of the most promising methods is the synthesis in gas phase by CVD [3]. This method, which can be potentially scaled for mass production, allows for the production of amorphous and polycrystalline Si particles in the size range 0.5–8 µm and with exceptional spherical and surface quality. However, the fabrication of monocrystalline particles with controlled size, and the ability to precisely control the distribution over a surface still remains a challenge. In this poster we present a material consisting of high-quality monocrystalline silicon quasi-spheres with a controlled size and distribution over the surface. This material offers high possibilities in any field where light managing plays an important role, such as photovoltaics and photodetectors.

References

[1] M. Garín, R. Fenollosa, R. Alcubilla, L. Shi, L.F. Marsal, & F. Meseguer, Nature communications **5** (2014) 3440.
[2] M. Garín, R. Fenollosa, P. Ortega, and F. Meseguer, J. Appl. Phys. **119** (2016) 033101.
[3] R. Fenollosa, F. Meseguer, and M. Tymczenko Adv. Mater. **20** (2008) 95–98.

Figures



SEM image, top view, of a square array of monocrystalline silicon quasi-spheroids.