High precision fabrication for light management at nanoscale

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Future light-based technologies should deliver us energy, food, fast communications, and sensors. For light-matter interactions occurring on atomic and molecular level we still need to develop better tools to control light at nanoscale via nano-fabrication and manipulation of nano-objects. In this talk our recent advances in high precision nanofabrication using 3D approaches and combining standard cleanroom tools with laser direct writing capabilities will be presented.

Combination of electron beam lithography (EBL) with post-processing of nanoparticels with Ga-ion milling opens a possibility of sub-20 nm direct write of nano-inscriptions on nanoparticles. Arrays of identical nanoparticles were fabricated with high fidelity and with uniform nano-features. This approach was key to make chiral plasmonic nanoparticles which show strong optical dichroism and can be used for optically driven motors and nano-tweezers. Controlled resizing of ion-milled nanopores over the range of sizes from 100 nm to several nanometers in nano-membranes is achieved using electron beam scanning.

Surface charging which is a common problem in applications of ion milling and electron imaging is resolved with co-illumination of deep UV light whose photons have energy larger than the electron work function for a given material. EBL and IBL can be both optimized for a high throughput for simple sample geometries. 3D laser fabrication of micro-optical elements and nano-textured surfaces adds new applications in lab-on-chip and sensing.