

Nanolithography by plasmon-based free-radical photopolymerization

Olivier Soppera², Claire Deeb¹, Carole Ecoffet², Renaud Bachelot², Jerome Plain² and Alexandre Bouhelier³

¹Université de Technologie de Troyes, France

²IS2M – CNRS UMR 7361, France

³Université de Bourgogne, France

An approach recently proposed for controlling photolithography at nanoscale consists of using plasmon resonances in metal nanostructures to confine and enhance optical fields. Plasmonic confinement and enhancement were successfully used to induce a local photopolymerization reaction. Photoinduced processes are of considerable interest for harnessing and controlling polymerization reactions at the nanoscale beyond chemical methods based on surface-confined living polymerization. The approach can be effectively employed for designing hybrid nanostructures with polarization-dependent optical properties, for quantitatively determining local electromagnetic field magnitude, and for developing advanced subwavelength optical lithography techniques.

We focus here on the mechanisms responsible for nanoscale photopolymerization induced by confined and enhanced electromagnetic fields. Surface plasmon dipolar resonance of individual Ag nanoparticles was used as an optical near-field source to locally trigger the reaction of a photopolymerizable formulation. We found that the diffusion of the dye is the main process limiting the polymerization reaction, as opposed to what is observed at the microscale with an equivalent chemical system. This approach demonstrates that plasmon-based polymerization can achieve true nanometer scale resolution and also provides a unique opportunity to investigate photochemistry at this length scale.

Biography

Olivier Soppera completed his Ph.D. in Polymer and Photochemistry (Université de Haute-Alsace) in 2003 and then went to Porto University-Portugal for a post-doctoral position (European Marie Curie Grant). He joined CNRS in 2004 as a senior researcher. He is now at Institut de Sciences des Matériaux de Mulhouse (IS2M – CNRS LRC 7228). His current research activities are focused on photomaterials for micro and nano-fabrication for applications in optics, photonics and biology. Olivier Soppera received the Médaille de Bronze du CNRS in 2009 for his research work.

olivier.soppera@gmail.com