Nanocrystal doped glass and fibers: Fabrication challenges and opportunities for novel photonics applications

Heike Ebendorff-Heidepriem

Deputy Director of the Institute for Photonics and Advanced Sensing (IPAS)

Deputy Director of the Optofab Node of the Australian National Fabrication Facility (ANFF)

ARC Centre of Excellence for Nanoscale BioPhotonics (CNBP)

School of Physical Sciences

The University of Adelaide, Australia

An intriguing approach to imbue glass with unique photonic properties is the creation of luminescent nanocrystals in glass and fiber. This is achieved either by direct doping of ex-situ prepared nanocrystals into glass or by in-situ growth of nanocrystals in the glass. This paper will present recent progress on direct doping of upconversion nanocrystals for fundamental investigations and diamond nanoparticles for magnetic field sensing as well as precipitation of gold nanoparticles for plasmonic-based applications. The ex-situ technique of direct doping of nanocrystals has the challenge of balancing the undesired dissolution of the nanocrystals with the required dispersion of the nanocrystals in the glass matrix during glass processing at elevated temperature. The advantage is the unprecedented control of the nanocrystal type and location as demonstrated for fibers with intrinsic magnetic field sensitivity. The in-situ growth of nanocrystals has the challenge of engineering the glass composition to achieve controlled precipitation of the nanocrystals at elevated temperature. A novel method of controlling the size and concentration of gold nanoparticles in tellurite glass paved the way to extraordinary tuning of plasmonic effects.