LASER-REDUCED SILVER NANOCLUSTERS IN POLYMER FILMS

Puskal Kunwar[1], Jukka Hassinen[2], Nazanin Karimi[1], Godofredo Bautista[1], Juha Toivonen[1], Robin H. A. Ras[2]

[1]Department of Physics, P.O. Box 692, FI-33101 Tampere University of Technology, Finland
[2]Department of Applied Physics, P.O. Box 11000, FI-02150 Aalto University (Helsinki University of Technology), Finland
email: puskal.kunwar@tut.fi

Metal nanoclusters are highly functional luminescent nanomaterials, which exhibit extraordinary physical and chemical properties that are different from their bulk counterparts [1]. Silver nanoclusters are usually prepared by reducing the silver salt by chemical, electrochemical, radiolytic reduction, and photo-reduction [2]. However, it is highly challenging to preserve the enhanced functionality of these nanoclusters without proper stabilizing environment [2]. The stabilizing environment can be polymer, DNA, dendrimers, polymer microgel or multiarm star polymer etc. Nevertheless, direct laser writing has also been used to produce highly stable silver nanoclusters in inorganic stabilizing medium such as glass and zeolites [2].

We demonstrate an efficient formation and stabilization of silver nanoclusters in an organic matrix, poly(methacrylic acid) (PMAA) by laser reduction [3]. The laser reduction technique is utilized to write sub-micron scale fluorescent structures comprising of silver nanoclusters. The as-formed nanoclusters exhibit a broadband emission at visible wavelengths with better photostability compared to Rhodamine 6G dye. The laser writing technique is also applied to prepare silver nanoclusters embedded in compositionally different polymer matrix Polyvinyl alcohol (PVA). The proposed approach is further extended to a cost-effective fast parallel fabrication of fluorescent microstructures by using holographic beam shaping with a spatial light modulator. The use of spatial light modulator induces the flexibility in this novel technique of fabrication with a resolution comparable to the direct laser writing. We anticipate the as-formed nanoclusters could be used in applications such as data storage, imaging and labelling.

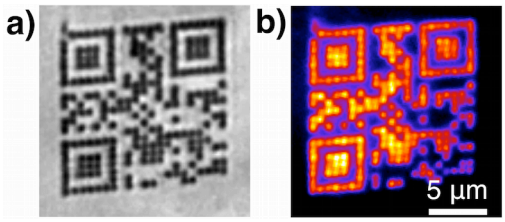

Figure 1. a) Bright field and b) fluorescence microscopy image of QR code fabricated in Ag@PMAA sample.

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