Two-photon laser fabrication of 3D silver nanowire microstructures and their plasmonic applications

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We have developed a laser photochemistry process to fabricate, by direct writing, 3D metallic microstructures using a two-photon microfabrication machine (http://www.teemphotonics.com). In this work we report the optical properties of silver nanowire microstructures. Typical nanowire diameter and length are 300 nanometers and 10 microns, respectively.
In the first part of the presentation we will present the diffraction properties of parallel nanowires with inter-distances in the 0.8 to 4 microns range. The interference of individual interference patterns gives rises to focusing effects that have the characteristics of ideal ultrasmall microlens with focal lengths in the micron range and with resolution limited by diffraction, i.e. in the 300 nm range in the visible. We will show that a 3D arrangement of such nanowires lead to an efficient chromatic spatial dispersion that may open a new route for RGB separation of colors at the micron scale.
In the second part of the presentation we will describe the optical properties of arrays of vertical nanowires with interdistances in the 0.8 to 4 microns range. The re-organized incident electromagnetic field is concentrated along the nanowires as shown by 3D wide-field microscopy and FDTD calculations. We will present how we have used this electromagnetic field enhancement to improve the detected signals from Raman and fluorescences nanoprobes.

References

[1] L. VURTH, P. BALDECK, O. STÉPHAN, G. VITRANT, « Two-photon induced fabrication of gold microstructures in polystyrene sulfonate thin films using a ruthenium(II) dye as photoinitiator », *Appl. Phys. Lett.* 92, 171103 (2008)

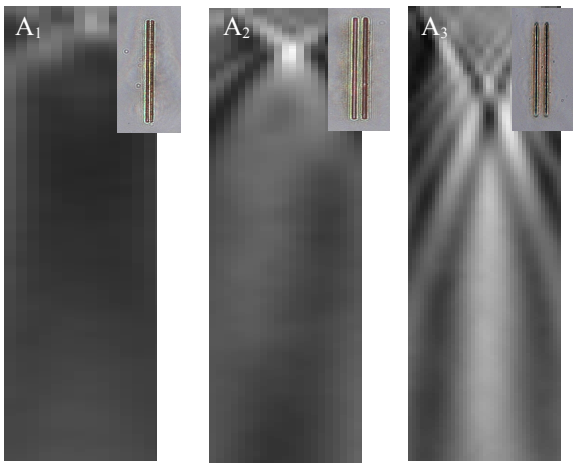

Figure 1 Focusing effects obtained by the diffraction of silver nanowire pairs separated by 1, 2 and 4 microns for A1, A2 and A3, respectively