Scattering scanning near-field optical microscopy for surface mapping of complex refractive index

Denis E. Tranca[1], Stefan G. Stanciu[1], Radu Hristu[1], Brent Witgen[2] and George A. Stanciu[1]
[1]Center for Microscopy-Microanalysis and Information Processing
University Politehnica of Bucharest, Romania
[2]Development Bioanalysis, Global Research, Novo Nordisk Park, Måløv, Denmark
E-mail: stanciu@physics.pub.ro

KEY WORDS: near-field microscopy, complex refractive index, sub-wavelength resolution.

Scanning Near-field Optical Microscopy (s-SNOM) [1] is mainly used in applications like near-field infrared absorption, qualitative studies of organic and inorganic materials, 2D materials, oxides and semiconductors, and imaging of surface plasmons on metals and optical antennas. However, most of these studies provide images that describe the variations of the amplitude and phase of the optical near-field, which in the best case can be used for highlighting differences between the investigated materials.

Recent studies succeeded to quantitatively measure optical properties (dielectric function and absorption) of materials with nanoscale resolution both in infrared and visible domains. Our study [2] demonstrated that in the visible domain it is possible to measure the complex dielectric function not just for dielectrics but also for metals and semiconductors.

Our most recent approaches deal with biological tissues and cells for quantitative optical measurements with nanoscale resolution. For this type of materials it's more convenient to use the refractive index instead of dielectric function, therefore we managed to convert the data obtained for dielectric functions into complex refractive indexes. Moreover, the algorithm for dielectric function measurement was extended and it is applied for every pixel in the s-SNOM images, therefore offering at the output a nanoscale map of the refractive index.

This work has received support from the European Community's Seventh Framework Programme FP7/2012-2015 under grant agreement no. 280804 and no. 212533, and by the PN-II-RU-TE-2014-4-1803 (MICRONANO) Research Grant, funded by the Romanian Executive Agency for Higher Education, Research, Development and Innovation Funding (UEFISCDI).

[1] C. Stoichita, S. G. Stanciu, G. A. Stanciu, "Near field investigation based on a novel aperturless near field optical microscope", *ICTON Mediterranean Winter Conference*, p. 1-3 (2009).

[2] D. E. Tranca, S. G. Stanciu, R. Hristu, C. Stoichita, S. A. M. Tofail, G. A. Stanciu, "High-resolution quantitative determination of dielectric function by using scattering scanning near-field optical microscopy", *Scientific Reports*, 5, 11876 (2015).