

Nanooptics and nanophotonics

Characterization of the nonlinear

optical properties of harmonic nanoparticles

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Harmonic Nanoparticles (HNPs) are a new family of bio-markers for multiphoton imaging exerting the optical contrast by the second and the third harmonics generation [1]. Considering this growing interest, dedicated nonlinear optical (NLO) characterization methods of the HNPs are required. In this work the efficiencies of second harmonic generation (SHG) under femtosecond laser excitation at **800 nm** and third harmonic generation (THG) under nanosecond laser excitation at **1064 nm** were used for HNPs diagnostics [2,3]. The comparison of SHG and THG of KNbO₃, BiFeO₃, KTP and LiNbO₃ HNPs colloids were done. The impacts of ZnO and BFO HNPs size and LiNbO₃ HNPs shape (spherical and cubic) were studied.

It was shown that SHG signal intensity depends on the of the pump excitation as $I_{2\omega} \sim I_{\omega}^p$, where $p = 2$ for KNbO₃, KTP and LiNbO₃ HNPs colloids. For ZnO nanoparticles parameter $p \sim 2.3$, that may be associated with the manifestation of higher order nonlinear processes. It was obtained for the first time the magnitudes of third order nonlinear susceptibilities $|\chi^{(3)}(3\omega=\omega+\omega+\omega)| \sim 10^{-18} \text{ m}^2/\text{V}^2$ of ZnO HNPs that depended on the size of the nanoparticles.

The obtained results indicate that the applied approaches are promising for the comprehensive HNPs colloids characterization.

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2. Barbano, E. C., K. Harrington, S. C. Zilio, L. Misoguti. Third-harmonic generation at the interfaces of a cuvette filled with selected organic solvents. *Applied Optics* **55**, (3) 2016, 595–602.
3. Débarre D., Beaurepaire E., Quantitative Characterization of Biological Liquids for Third-Harmonic Generation Microscopy. *Biophysical Journal*. – 2007.–**92**, 603–612.