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Luminescence and dispersion properties of plasma-modified ZnO nanoparticles for bio-imaging
バイオイメージング用プラズマ修飾Zn0ナノ微粒子の発光および分散特性

Mihai Alexandru Ciolan[1,3], Iuliana Motrescu[2], Dumitru Luca[3], Masaaki Nagatsu[1]
ミハイ　アレクサンドル　キョラン[1,3]、イウリアナ　モトレスク[2]、ドミトル　ルカ[3]、永津雅章[1]

[1]Graduate School of Science and Technology, Shizuoka University,
[2]Research Institute of Electronics, Shizuoka University,
3-5-1 Johoku, Nakaku, Hamamatsu 432-8011, Japan
[3]Department of Physics, "Alexandru Ioan Cuza" University, 11, Carol I blvd., 700506-Iasi, Romania

[1]静岡大学 創造科学技術大学院
[2]静岡大学　電子工学研究所
〒432－8011　静岡県浜松市中区城北3-5-1
[3]物理学科, アレクサンドルイワンクザ大学、１１カロル１、７００５０６イアシ　ルーマニア

Surface modification of nanomaterials is of great interest nowadays due to the possibility to add functional groups that can improve the properties of the materials.

Due to the toxicity and other drawbacks of materials (e.g. CdSe, CdTe, ZnS) currently used as quantum-dots, we propose the use of plasma processed ZnO which is a versatile semiconductor and has other features among which is the compatibility with the living organisms. All these qualities promote it to be used as an alternative for the existing materials for bio-imaging applications.

We produce ZnO nanoparticles in our lab by ablating ZnO commercial target (purity of 99.999%) using millisecond Nd-YAG laser with a wavelength of 1064 nm with a power of 7 J/pulse. By pulsed laser ablation technique (PLD) we obtain nanoparticles with controllable size of 20 to 100 nm.

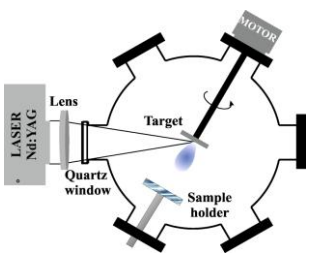

Figure 1. Schematic representation of the Nd:YAG PLD experimental setup

The functionalization of ZnO nanoparticles (NPs) surface was performed by low temperature plasma processing using surface wave excited ammonia plasma (SWP). This is an important step necessary for improving the sensitivity and selectivity of ZnO NPs for various biomolecules and creating reactive sites for covalent binding. The functional groups introduced on the surface, in this case amine groups, serve as linkers for other biomolecules depending on the desired outcome. XPS measurements correlated with chemical derivatization measurements show an increase of the amide and amine groups in the sample treated in SWP excited ammonia plasma proving the successful functionalization of the ZnO NPs.

In this study, luminescence and dispersion properties of surface functionalized ZnO NPs are studied as well since our aim is to employ these materials for a bio-imaging technique.

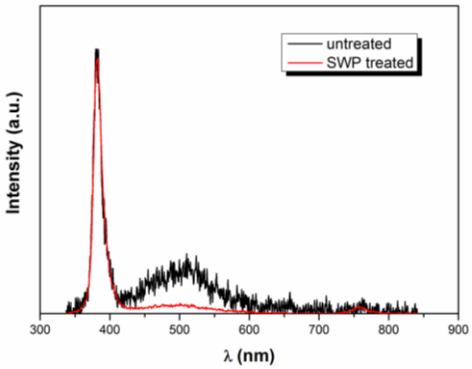

Figure 2. PL measurements of ZnO obtained by PLD and SWP treated.

In figure 1 are shown the photoluminescence (PL) measurements of the sample treated in SWP plasma. A strong sharp peak at about 381 nm is observed. The luminescence of the sample gives us good premises to use ZnO NPs as materials for imaging application. Further discussion on how the plasma treatment affects the luminescence of the ZnO nanoparticles will be discussed at the conference.