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プラズマ表面機能化酸化亜鉛ナノ材料に固定化した糖鎖の光学的検出
Optical detection of sugar chains connected to plasma aminated zinc oxide nanomaterials

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In our previous studies we have proposed the use of zinc oxide (ZnO) nanoparticles for bioimaging applications: nanoparticles are produced by pulsed laser ablation, amine groups are introduced on their surface using dry plasma processing, and then biomolecules are connected to the amine functionalities. The preparation steps are schematically presented in Fig. 1.

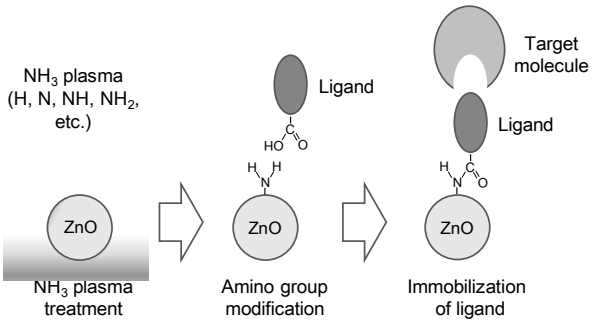

Fig. 1 Schematic representation of ZnO nanoparticles preparation for bioimaging applications

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We have proved that surface wave plasma excited in ammonia and mixtures of ammonia and argon successfully functionalize the surface of ZnO nanoparticles with amine groups, and, in some conditions, it enhances their photoluminescence. Our focus further goes to the possibility of biomolecule binding to the amine groups. In this study we study the connection of sugar chain (dextran) to amine groups introduced on the ZnO nanoparticles by means of fluorescence and photoluminescence measurements.

We tested the possibility of sugar chain connection using two methods: connection of fluorescence labeled dextran, and fluorescence detection of dextran's hydroxyl groups after the reaction of unlabeled dextran with the amine functionalities on the nanoparticles. In the first method, fluorescent dye labeled dextran (fluorescein isothiocyanate-dextran – FTIC-dextran, 40.000 Da) is first oxidized and then reacts with plasma treated ZnO NPs samples. The substrates with deposited and aminated ZnO NPs are visualized using fluorescence microscope; in the same time, equal quantities of NPs are removed from the substrates and analyzed in liquid by fluorescence spectrophotometer for quantification of fluorescence.

For the second evaluation method dextran (unlabeled) is firstly oxidiezed, then reacts with the samples. Hydroxyl group specific fluorescent dye (5-(4,6-Dichlorotriazinyl) Aminofluorescein – 5-DTAF) is used to detect detran's free hydroxyl groups. The detection is performed in the similar way as for the FTIC-dextran. Fig. 2 shows the comparison between the results of the two methods, visualized at fluorescent microscope for untreated samples and for plasma aminated samples, respectively. It is clear that in both methods dextran is successfully connected to the amine groups introduced on the surface of the nanoparticles by plasma processing. Details about quantification of fluorescence in different processing conditions will be presented in the conference.

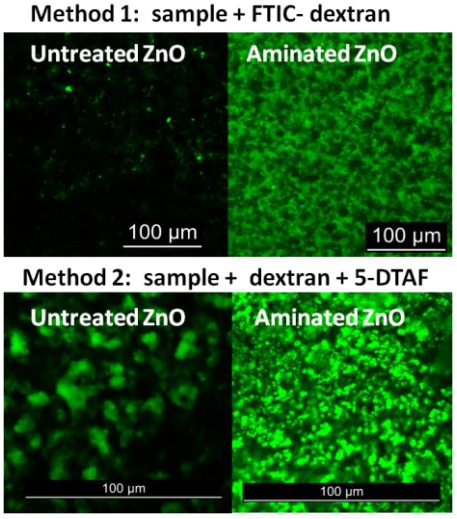

Fig. 2 Fluorescence microscope images of untreated and plasma aminated ZnO after reaction with dextran using two methods.