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ZnO ナノ微粒子の存在下におけるアミノ酸の窒素プラズマ修飾

Nitrogen Plasma Modification of Amino Acids with or without ZnO Nanoparticles

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Low temperature plasma processing of materials offers a wide range of advantages, especially when talking about processing sensitive substances such as biomolecules. So far we have proved the ability of surface wave plasma (SWP) to induce the loss of biological function of peptide molecules but also the possibility to create new connections between amino acid molecules.

In the same time, plasma proved useful for nanomaterials functionalization, such as amine group introduction on the surface of ZnO nanoparticles. Functionalization is just the first step of materials preparation for biomedical applications, and it should be followed by connection of biomolecules for specific targeting such as amino acids. Both or at least one of these steps is presently performed in liquid phase, in extremely complex and sophisticated procedures. With the aim of performing both these steps in the same time, which means enrichment with functional groups and biomolecules in the same time during plasma processing, the first step is to check and compare the processing of amino acids with and without the presence of ZnO. This is done from the point of view of sample composition and modification andalso from the point of view of mass spectrometric analysis during plasma processing.

Surface wave plasma excited in nitrogen was used for processing. Cysteine (Cys) was preferred as amino acid due to its multitude of functional groups available for connection (thiol, amine, hydroxyl). Suspecting ZnO activation by ultraviolet radiation, a comparison is made between direct plasma treatment and only plasma radiation exposure. The effects on Cys are stronger in the latter case, fact confirming ZnO activation by UV exposure.

Beside the effects on Cys molecules after processing with and without ZnO, in the first case the samples were separated by repeated wash and centrifugation, Cys being water soluble in contrast with ZnO. Ninhydrin assay derivatization shown that the separated ZnO contains amine and amide groups (as shown in Figure 1 by comparison with untreated ZnO and also the samples exposed to plasma radiation), fact which indicates a connection between ZnO and Cysteine processed in the reactive media represented by nitrogen surface wave plasma. In the same time, the processing was monitored by mass spectrometry, the results being correlated with those of sample analysis.

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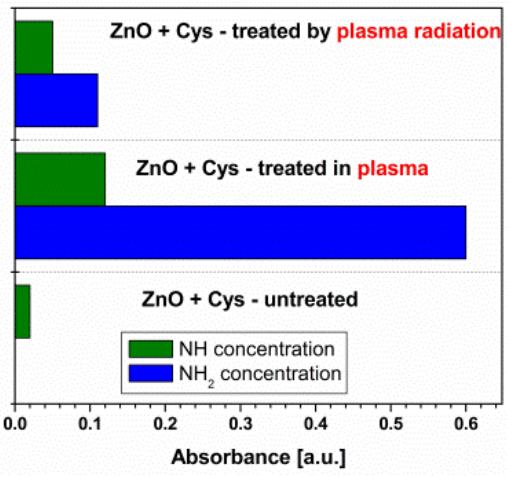

Fig. 1 Comparison between amine (blue) and amide (green) groups detected by derivatization for ZnO+Cys sample exposed to 5Pa nitrogen plasma radiation, plasma and untreated, respectively.