S1-04

Gold Nanoparticle-Enhanced Secondary Ion Mass Spectrometric Analysis for Protein Kinase Assay

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Enhancing the signal of biomolecules is necessary for time-of-flight secondary ion mass spectrometry (ToF-SIMS) studies within many biological applications. We have developed an efficient method of inducing signal enhancement of secondary ions from peptides by using gold nanoparticles (AuNPs) [1]. AuNPs function both as signal enhancer and effective binding sites for peptides on a well-controlled surface such as self-assembled monolayers (SAMs), thus allowing for well-contrasted ToF-SIMS images of peptide modification. By employing this AuNP-enhanced SIMS (NE-SIMS), the phosphorylation and inhibitory effects were quantified as a result of its detection of the mass change of the peptide substrates due to kinase reaction [2]. Efficiency of phosphorylation was dependent on the surface orientation and length of the peptide substrate that affected the accessibility of the kinases on the three-dimensional AuNPs. Unlike antibody or fluorescence-based detection, this NE-SIMS approach allows a straightforward identification of peptide modification in a label-free manner on various surfaces, such as glass, Si and gold. In combination with the microfluidic and microspotting techniques, the NE-SIMS also allowed for a high-throughput and multiplexed mass images for protein kinase assay. Our study suggests that NE-SIMS can be a powerful tool for the assay of various kinases and screening of their inhibitors with high sensitivity and specificity.

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[2] Y.-P. Kim, E. Oh, Y.-H. Oh, D.W. Moon, T.G. Lee, and H.-S. Kim. *Angew. Chem. Int. Ed.* (2007) In press.