Poster

POTENTIAL OF ENZYMATIC SILVER DEPOSITION

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The fast development in DNA Microarray technology is founded in the search for simple, cost effective and fast methods for the detection of biomolecules. At the moment biomolecules like DNA, proteins and others are mainly detected by marking them with fluorescence dyes. This technique is highly sensitive and broadly established but shows also disadvantages, for example photo bleaching and quenching.

In the last years metal nanoparticles showed the potential to be an alternative marker for the detection of biomolecules. Nanoparticles offer various unique properties, for this reason different approaches have been developed for the detection of nanoparticle labeled biomolecules, for example electrochemical, optical and gravimetric methods.

This work presents an electrical method for DNA detection. It is based on the electrical detection of nanoparticle-labeled DNA by the immobilization of the particles in the gap between two microstructured electrodes on the surface of a DNA chip. In case of a binding event the capture DNA immobilized in the gap binds their specific partners (target), and gold nanoparticles are bound to a special modification in the target molecule. Finally, silver is deposited on the bound gold nanoparticles. The metal enhancement step leads to a bridging of the gap between the electrodes and a decrease in the measured resistance over the gap (Fig. 1).

The main problem with this method is the increasing background at longer silver enhancement times. Therefore an alternative enhancement system was tested. In this connection an enzyme, horseradish peroxidase, replaces the gold nanoparticles. Only the enzymatic activity of horseradish peroxidase is responsible for the silver deposition. With this system we were able to improve the sensitivity and to minimize the background due to the highly specific, localized silver deposition. In order to further optimize this approach, a better knowledge is required about the kinetics of silver enhancement of gold nanoparticles and horseradish peroxidase for the quantification of our results on the electrical DNA-Chip.

For that purpose the enzyme was immobilized on mica and the growth of these enzymatically formed silver particles was analyzed with the AFM at the single particle level (Fig. 3). To give a statement about the enzyme kinetics, particles with different enhancement times were

measured. After that every single particle was characterized in height and volume to determine the enzyme kinetics. Furthermore the potential was investigated to create DNA-guided electrical pathways based on the enzymatic metal enhancement (Fig. 4).

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Urban, M.; Möller, R.; and Fritzsche, W. *Review of Scientific Instruments* **2003,** 74, 1077-1081.

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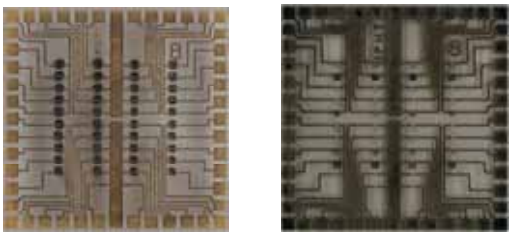


Fig. 1: screen printed chips with gold and platin structures after enzymatic silver deposition

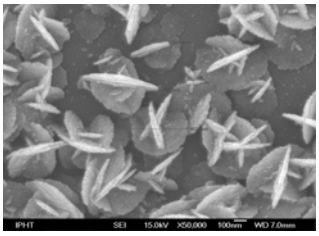
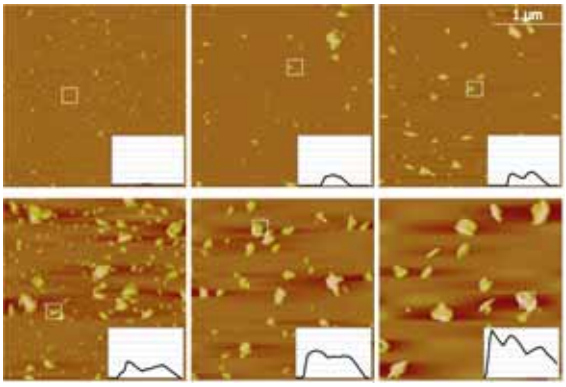


Fig. 2: SEM image, particles after enzymatic silver deposition



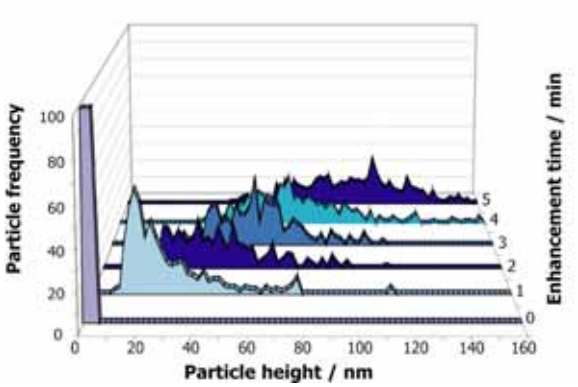


Fig. 3: Stepwise metal deposition by the enzyme in 1 min steps starts at the image on the top with the untreated enzyme complex and ends at 5 min silver enhancement shown in the image on the bottom (right), the particle height distribution is shown in the diagram

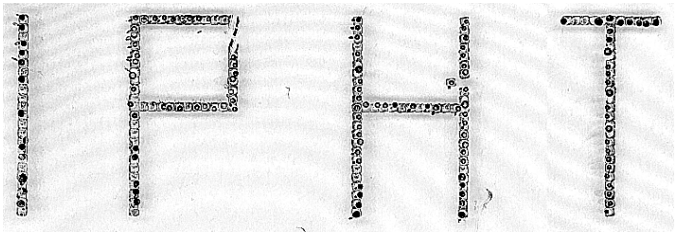


Fig. 4: slide spotted with DNA and silver enhanced by the enzyme