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Biomimetic ion conducting nanopores in polymeric foils as bio-molecular chemical sensors: the iNAPO project**Wolfgang Ensinger, Markus Biesalski, Gerd Buntkowsky, Kay Hamacher, Bodo Laube, Helmut F. Schlaak, Gerhard Thiel, Christina Trautmann, Nico van der Vegt and Michael Vogel**

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The iNAPO-project is run by a group of materials scientists, biologists, chemists, physicist and electrical engineers. One of the main purposes is the development of biomimetic (bio)molecular sensors based on ion conducting nanopores in polymer foils. The basic principles of fabrication and working mechanism of such a nanosensor are described. PET foils are irradiated with a highly energetic single ion of a heavy element at the particle accelerator at GSI Helmholtz-Center in Darmstadt. The ion damage zone in the polymer is chemically etched into a conical pore, with the small aperture being in the nm range. The nanopore walls are functionalized with a biorecognition unit, i.e. a molecule which specifically reacts with a molecule to be analysed. In an electrochemical cell, the foil acts as separation membrane. The electrolyte current flowing through it is measured as a function of the applied potential. In the presence of specific analyte molecules, which bioconjugate with the biorecognition unit, these ionic currents are changed. Thus, a highly sensitive nanosensor is available. The preparation and working principle of the nanosensor is described. As an example, results on protein sensing are shown. In Fig. 1, the quantitative measurement of the protein Concanavalin A that specifically bioconjugates with mannose is depicted. The concept of the functionalized ion conducting nanopores can be applied to a large number of biorecognition couples. Within the project iNAPO, the potential of this technique will be further explored. In a step further, it is planned to embed protein-based nanopores with even better selectivity into polymer membranes. Eventually, the membranes will be incorporated in electronic micro sensing devices thus creating a new type of (bio)molecular sensor. The development is supported by analytical studies based on NMR and by theoretical and simulation studies.

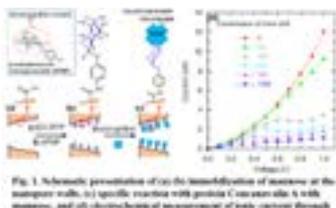


Fig. 1. Schematic presentation of the biomimetic ion conducting nanopores in polymeric foils. (a) Schematic of the nanopore structure and its functionalization with mannose units. (b) Graph showing the specific reaction of the nanopore with protein Concanavalin A, resulting in a change in the electrochemical current.

Biography

Wolfgang Ensinger studied Chemistry and Physics at the Universities in Karlsruhe and Heidelberg in Germany. He received his PhD in 1988 from Heidelberg University. Thereafter, he was a Guest Researcher at Osaka National Research Institute in Japan, Lecturer at Institute of Solid State Physics at University Augsburg and Professor of Analytical and Nuclear Chemistry at University of Marburg. Since 2004, he is a Full Professor of Material Analysis at Technical University of Darmstadt in Germany. His research topics include formation of thin films and nanostructures, including nanochannels, nanowires and nanotubes. He has authored/co-authored more than 300 peer-reviewed scientific publications.

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