Membrane based technology for environmental photoelectron microscopy: first tests, opportunities and challenges

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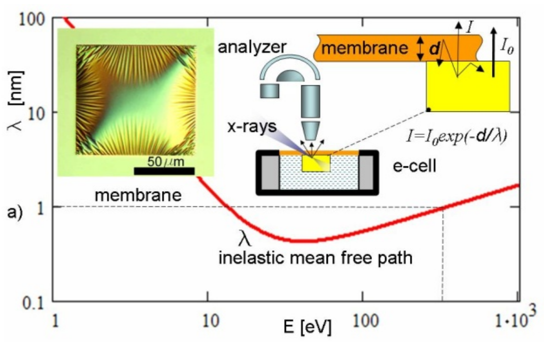
Novel nonstructural materials constitute currently the major source of innovations in energy harvesting, storage and production. The similar trend exists in bio-medical applications of the nanostructures. For a vast amount of applications such as in fuel cells, supercapacitors, batteries, drug delivery, aerosols, catalysis etc, the performance of these new materials and devices depends on physical and chemical processes taking place at the interface of the nanostructured active element and environment (i.e. electrolyte, water, air, blood plasma etc). To understand surface phenomena and rationally tune the performance of these active nanostructures and devices *in situ* spectroscopic access to interfacial processes at nanoscopic level is required. Surface sensitive analytical techniques such as XPS, AES would be an ideal choice to address these goals. However, due to the so called “pressure gap” these powerful methods are not readily applicable to the objects immersed in a dense gas or liquid environment. In this presentation[1], taking advantage of the very recent developments in fabrication of ultrathin (~1 nm) membranes which thickness is comparable to escape depth of 200-1000 eV photoelectrons, we report on



Calculated inelastic mean free path for C predicts that the detection of photoelectrons having the kinetic energy in order of few hundred eV is possible through the 1 nm membrane. The insert depicts the principal of the experimental setup: to minimize the effective escape length of the axis of the electron analyzer has to be normal to the membrane plane. The illumination with x-rays can be made under the grazing angle since their attenuation is much smaller in comparison with the electrons. Left insert: prototype 5 nm Si thick membranes which were use for preliminary tests

the methodology to probe the samples *in situ* through the membrane using SPEM. The design of the specialized hardware along with membrane handling protocols will be discussed and test experiments will be described.

[1] Andrei Kolmakov, Dmitriy A. Dikin, Laura J. Cote, Jiaxing Huang, Majid Kazemian Abyaneh, Matteo Amati, Luca Gregoratti , Sebastian Gunther and Maya Kiskinova (pending)