



Mini-symposium on *operando* spectroscopy in materials research

Wednesday, 22 January, 2020 (14:00 – 16:00)

Avogadro room, Kjemibygningen, Sem Sælands vei 26, Blindern 0371 Oslo

14:00-14:50

Using APXPS to study ALD processes

Dr. Esko Kokkonen

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Atomic Layer Deposition (ALD) techniques find a wide range of applications in the semiconductor industry, catalysis, and materials science. Advanced experiments at synchrotron-radiation facilities play an increasingly important role in fundamental investigations of ALD processes. In line with this general trend, there has been a considerable increase in ALD-related research at the MAX IV Laboratory, especially in the APXPS beamlines HIPPIE and SPECIES. In this talk, I will give a short introduction to these beamlines and how typical APXPS studies are performed when ALD processes are investigated. As an example, we have studied the ALD of HfO₂ on InAs from tetrakisdimethylamido-hafnium (TDMA-Hf) and water in fully in-situ and in-operando APXPS experiment. A complete removal of the native oxide layer was confirmed during the first ALD half-cycle. Studies have been carried out with improved time-resolution where we have monitored simultaneously the As 3d, In 3d, In 4d, Hf 4f and C 1s core-levels, revealing the time sequence of the removal of different As- and In-oxide components, and Hf surface chemistry.

14:50-15:00

Coffee and cake

15:00-15:50

In situ and ‘operando’ spectroscopy for materials and oxidation catalysis – time and non-innocence!

Prof. Wesley R. Browne



Molecular Inorganic Chemistry, Stratingh Institute for Chemistry, Faculty of Mathematics and Natural Sciences, University of Groningen, Groningen, The Netherlands

Operando spectroscopy is a central tool in understanding chemical reactivity and in providing guidance to control and direct reactivity. Spectroscopic characterization makes use of the full EM spectrum and the choice of technique is largely governed by the characteristics and composition of the material and in particular ‘where’ we look - in bulk or on/at a surface. A furthermore complication is the non-innocence of techniques in such studies especially where changes, either spontaneous or stimulated are followed over time. In this lecture I will discuss challenges and opportunities in the use of operando spectroscopy in several distinct situations ranging for catalyzed reactions, where we look at the role and fate of catalysts as well as the catalyzed reaction itself, with a particular focus on oxidation catalysis. Finally I will discuss briefly molecular based responsive materials and their functional characterization in operation as self-assembled monolayers, polymer films and hybrid inorganic-organic structures. In these examples I will seek to highlight both the challenges and the opportunities that operando spectroscopy, and especially Raman spectroscopy, provides us.