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Abstract:

Hydrogen based materials research

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Hydrogen is a vital element in the energy transition. While sustainable energy sources such as solar and wind plants will power the planet, this energy needs to be converted in chemical bonds to provide storage, fuel and resources to our future energy system. Hydrogen is the most simple chemical bond that can be made by electrochemistry. Given the materials involved in electrolysis and the intermittent nature of its use when powered by sustainable sources, the production cost of electrochemically produced hydrogen is far from competitive. In this talk I will discuss some of our efforts to produce hydrogen with various levels of integration with on the one hand solar PV sources and on the other hand battery storage. The integration of different functionalities is challenging but may lead to substantial cost reduction.

Apart from producing hydrogen, we also need ways to purify and detect it. Here, we make use of the optical changes in metals on hydrogenation. This allows us to develop optical fiber based hydrogen sensors. When using Hf as a detector, we obtain an extremely large sensing range covering 6 orders in hydrogen pressure. Finally, also the purification of hydrogen using metal hydride membranes still provides a challenge to our understanding of hydrogen transport. Using optical methods again, we find that the existence of heterogeneous fcc/hcp phase boundaries contributes to a large extent to the fast permeation observed in PdCu-based membranes.

Bio:

Bernard Dam obtained his PhD in 1986 in Nijmegen on a thesis on the growth and morphology of incommensurately modulated crystals. After working as a researcher Philips Research Labs in Eindhoven on High-Tc superconductors and as an Associate Professor at the VU University in Amsterdam, he is now the head of the MECS (Materials for Energy Conversion and Storage) group at the Delft University of Technology. This group specializes in (photo-)electrochemical conversion processes with the aim to store the energy generated by fluctuating ‘sustainable electron’ sources. In addition, the group investigates the application of metal hydrides as hydrogen sensors and hydrogen separation membranes using a thin film combinatorial approach. The general focus of his research is the relation between thin film growth, the (defect)structure and the physical properties of materials.

In addition to his work in Delft, Bernard is member of the scientific board of the Hydrogen and Fuel Cell Joint undertaking (FCH JU, in Brussels) and scientific director of ‘Advanced Dutch Energy Materials (ADEM)’ a Dutch program to strengthen energy related materials research.