

第 26 回稲盛フロンティア研究セミナー

稲盛フロンティア研究センターでは、以下の講演会を開催します。ご参加は無料です。お気軽にご参加下さい。

日時:平成 28 年 12月 16日(金)16:00~17:00

場所:稲盛財団記念館 2F セミナー室



The Mechanisms of Proton Conduction in Systems based on Phosphorous Oxoacids

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From a fundamental point of view, the family of compounds known as phosphorous oxoacids are among the most intriguing proton conducting systems. Neat liquid phosphoric acid (H_3PO_4) has the highest intrinsic proton conductivity of any known substance, systems containing phosphates play a central role in the structure and function of biological systems and are attracting increasing interest as electrolytes for emerging fuel cell applications.

Here, we describe our current understanding of proton conduction in phosphorous acid based systems and compares this to the proton conduction mechanism in water and hydrated systems (such as Nafion). Most of our notion is based on recent ab initio molecular dynamics simulations, NMR and impedance spectroscopy indicating the formation of polarized chains by correlated proton transfers along chains of hydrogen bonds in a close sense to the original notion of Grotthuss mechanism for proton conduction in water. The depolarization process required to release long range proton transport (structural diffusion) is suggested to be controlled by “hydrogen bond network frustration”, i.e. the imbalance of the numbers of potential proton donors and acceptors.

The highest network frustration is observed for neat phosphoric acid which shows the highest structural proton conductivity. Higher ionic conductivities are observed with increasing water content, but this conductivity is related to the diffusion of extended charged species (e.g. H_3O^+ , $H_2PO_4^-$) which is detrimental e.g. for fuel cell performance.



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After receiving his Diploma in Mineralogy at the University of Cologne (1979), Klaus-Dieter Kreuer did a PhD in the department of Chemistry at the University of Stuttgart (1979-82). As a fellow of the “Studienstiftung des Deutschen Volkes” he benefited from a research stay at the California Institute of Technology (group of R. Vaughan, 1978) and a Max-Planck award allowed him to join the Massachusetts Institute of Technology (1983/84) as a visiting scientist. Later, Klaus-Dieter Kreuer built an R&D group for Electrochemical Sensors within a Swiss-German company (Endress & Hauser, 1985-91) before joining the Max-Planck-Institute for Solid State Research (1992), where he assisted J. Maier in building his new department. Since 1990 Klaus-Dieter Kreuer is lecturing (Werkstoffwissenschaften) at the University of Stuttgart from which he received his Habilitation degree (1999).

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