Mátrafüred 2022

International Conference on Chemical Sensors

June 12 – 17, 2022
Visegrád, Hungary

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Tuesday, June 14, 2022

Chair: Philippe Bühlmann

9.00–9.30 **Eric Bakker,** Elena Zdrachek, Tara Forrest, Polyxeni Damala
University of Geneva, Geneva, Switzerland
Symmetry with Solid-Contact Membrane Electrodes

9.30–10.00 Iryna Ivanko, **Tom Lindfors**, Rikard Emanuelsson, Martin Sjödin
Åbo Akademi University, Åbo, Finland
Conjugated Redox Polymer as Solid Contact in Potassium-Selective Electrodes

10.00–10.20 **Soma Papp,** József Kozma, Róbert E. Gyurcsányi
Budapest University of Technology and Economics, Budapest, Hungary
Solid-Contact Ion-Selective Electrodes Based on Redox-Functionalized Carbon Nanotubes for Improved Potential and Batch-To-Batch Reproducibility

10.20–10.40 Yi Heng Cheong, **Grzegorz Lisak**
Nanyang Technological University, Singapore
Bubbles in an Ion-Selective Membrane: New Approach to Control Accumulation of Water at Solid-Contact / Membrane Interface

10.40–11.10 **Coffee Break**

Chair: Eric Bakker

11.10–11.40 Kwangrak R. Choi, Xin V. Chen, Jinbo Hu, **Philippe Bühlmann**
University of Minnesota, Minneapolis MN, USA
Solid-Contact Sensors with Covalent Attachment of Ionophore and Ionic Sites to The Polymeric Sensing Matrix

11.40–12.10 Luca Gualgneli, Zekra Mousavi, Tomasz Sokalski, Ivo Leito, **Johan Bobacka**
Åbo Akademi University, Turku, Finland
Novel Design of a Flow-Through Potentiometric Sensors

12.10–12.30 Valentina M. Keresten, Anna V. Bondar, Andrey Yu. Vlasov, Elena V. Solovyeva, **Konstantin N. Mikhelson**
St. Petersburg State University, St. Petersburg, Russia
Non-Constancy of the ISE Membrane Bulk Resistance: Origin and Possible Practical Application

12.40 **Lunch**

15.30–16.00 **Coffee**

Non-Constancy of the ISE Membrane Bulk Resistance: Origin and Possible Practical Application

Valentina M. Keresten, Anna V. Bondar, Andrey Yu. Vlasov, Elena V. Solovyeva, **Konstantin N. Mikhelson**

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It is known that ionophore-based solvent-polymeric membranes of ion-selective electrodes (ISEs) contain droplets of water absorbed from solution. Therefore, these membranes, rigorously speaking, are essentially heterogeneous, consisting of a continuous organic phase and a dispersed aqueous phase. However, in theoretical models, the ISE membranes are considered homogeneous, and the presence of the dispersed aqueous phase is neglected. These models result in equations which nicely describe the ISE potentials and selectivity. These models also predict a constant value of the membrane bulk resistance within the Nernstian response range of an ISE. In contrast with the latter, our study revealed a significant variation of the membrane bulk resistance along with the concentration of the solution, and the magnitude of the effect increases at lower concentrations. Furthermore, the resistance correlates with the water uptake by the membranes [1, 2]. The explanation of these facts in view of the membrane heterogeneity will be presented. In a membrane the composition of the organic phase proper is constant within a certain range of the solution composition, and therefore the ISE obeys the Nernst equation, within this range. Lipophilic ion-ionophore complexes and ion-exchanger sites are confined to the membrane organic phase and avoid water droplets. Therefore, the presence of the droplets results in a decrease of the effective cross-section of the membranes. Additionally, if charged species encounter droplets, they must circumvent them, so the path-length of the species across the membrane increases. These two effects result in increase of the membrane bulk resistance along with water uptake [3]. A theory will be presented to explain why water uptake increases along dilution, although the chemical potential of water in diluted solutions is almost constant. It will be shown that the variation of the ISE membrane bulk resistance makes possible measurements of the concentration of the analyte in samples with an unknown ionic strength.

References

1. A. V. Kalinichev, E. V. Solovyeva, A. R. Ivanova, G. A. Khripoun, K. N. Mikhelson, Non-constancy of the bulk resistance of ionophore-based Cd^{2+}-selective electrode: A correlation with the water uptake by the electrode membrane, Electrochim. Acta **2020**, *334*, 135541.
2. E.V. Solovyeva, H. Lu, G.A. Khripoun, K.N. Mikhelson, S.G. Kazarian, In situ ATR-FTIR spectroscopic imaging of PVC, plasticizer and water in solvent-polymeric ion-selective membrane containing Cd^{2+}-selective neutral ionophore, J. Membr. Sci. **2020**, *619*, 118798.
3. V. Keresten, E. Solovyeva, K Mikhelson, The Origin of the Non-Constancy of the Bulk Resistance of Ion-Selective Electrode Membranes within the Nernstian Response Range, Membranes **2021**, *11*, 1050344.