**Sensing ion fluxes through artificial and biological membranes and their interfaces**

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Ion flux through a membrane surface (membrane-solution interface) is the condition of every electrochemical ion-sensitivity. This condition applies both to ion-selective membrane electrodes (ISEs) and biological membranes. In the field of ISEs, the transport of ions determines the electrochemical concentration-dependent signals. Ion transport through biological membranes is of vital importance for homeostasis of living organisms, in particular in neuronal signals and energy release.

The key application area of ISEs is in clinical chemistry, where routine measurements that are fast, inexpensive, reliable, service-free, and fully automated are of importance1. Today, ISEs are widely and routinely used for the determination of electrolytes (K+, Na+, Cl-) and pH in physiological fluids such as whole blood, serum, plasma or urine. In routine measurements, in hospital laboratories, flow-through ISEs are used, which allow for measurements in a drop-like sample volume (about 30 microliters) within a few seconds.

For measurements with biological membranes, the flow-through ISEs known from clinical applications were 3D-redesigned and placed on one flat surface to form a platform that can fit the cup with living bronchial epithelial cells. Two platforms work in proximity of the cells’ surfaces, basolateral and apical. In this way, the measurements in a small volume of solution (about 10 microliters) that bathes the cells for over a few hours was continuously performed.2

The tutorial shows how to formally (mathematically) characterize the ion fluxes and derive patterns of the membranes’ electrochemical responses using a Nernst-Planck-Poisson model (NPP).3 The membrane surfaces modified by ion concentration gradients over the membranes and the fluxes controlled by different primary to interfering concentration ratios or blockers of ion channels will be considered. The NPP will be presented as a gateway for practical realizations such as optimizing the performance of ion-selective electrode platforms, measurements in one-drop of blood, and characterization of ion-fluxes through a living endothelial cell layer.

References:

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