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What ion flow along ion channels can tell about their functional activity?

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The most direct method for verifying the functional activity of channel-forming peptides and proteins consists in monitoring the flow of physiologically relevant inorganic ions, such as Na⁺, K⁺ and Cl⁻, along the ion channels. Measurements of average and single channel currents across bilayer lipid membranes (BLMs) interposed between two aqueous solutions are extensively employed to this end. A major drawback of BLMs is their fragility, high sensitivity toward vibrations and mechanical shocks, and low resistance to electric fields. To overcome this problem, metal-supported tethered BLMs (tBLMs) have been devised, where the BLM is anchored to the metal via a hydrophilic spacer that replaces the water phase on the metal side. However, only mercury-supported tBLMs can measure and regulate the flow of the above inorganic ions, thanks to mercury liquid state and high hydrogen overpotential. Thus, they react to the presence of proteins, charges and physical forces in a dynamic and responsive manner, by reorganizing upon interaction with external perturbations and mimicking the functionality of living cell membranes. The potential of Hg-supported tBLMs is illustrated by the use of different electrochemical techniques. Moreover, a tBLM formed on a mercury cap electrodeposited on a platinum microdisk yields a micro tBLM that maintains the same fluidity and lipid lateral mobility as on a hanging mercury drop and allows the recording of single channel currents and of two-photon fluorescence lifetime images of lipid rafts and gel-phase microdomains, opening the way to its use in high throughput screening applications.

Biography

Rolando Guidelli obtained his degree in Chemistry at Florence University, Italy, and was appointed by Florence University as a Lecturer in Electrochemistry. He was then promoted to Full Professor of Electrochemistry in the Faculty of Science of Florence University. His scientific interests have been focused on electrode kinetics, structure of metal/water interfaces and bio-electrochemistry. He has won several distinguished prizes in the field of electrochemistry and has published more than 230 papers in reputed journals and several book chapters. Furthermore, he has served as the organizer of several conferences in the field.

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