Microbial Electrophysiology

Traditionally our understanding of the transmembrane electrical potential in microbes has been limited to energy transduction. The proton motive force (PMF) must be maintained to power established housekeeping functions such as ATP production and flagellar motors. However, an unexpected and growing body of evidence indicates that the situation is much more complex than previously anticipated. Results have revealed that the transmembrane electrical potential in bacteria is dynamic, and there are voltage-gated ion channels in the membrane that respond to stimuli to perform physiological functions that are beginning to be elucidated. This Special Issue, entitled “Microbial Electrophysiology”, is focused on the mechanistic and physiological basis for changes in the transmembrane electrical potential in bacteria and yeasts and is intended as a springboard for interdisciplinary innovations and ideas that will be reported in future issues of *Bioelectricity*. These will include bacterial systems spanning single cells and whole populations, and experimental contexts ranging from controlled laboratory environments to natural environmental communities.

Microbial bioelectricity has a wide-reaching relevance and this Special Issue emphasizes that. Articles come from contributing authors across the globe and highlight the rapid advances in bioelectricity-based research methods and application development. Contributions in this issue include exciting review and perspective articles including: Engineering biological electron transfer and redox pathways for nanoparticle synthesis (James Boedicker and colleagues from the University of South California), Seeking insights into ageing through yeast mitochondrial electrophysiology (Munehiro Asally and colleagues from the University of Warwick), Light controlled Bioelectrical Signalling: Towards all-Optical Electrophysiology in Bacteria (Paterno and colleagues from the Center for Nano Science and Technology, Istituto Italiano di Tecnologia), Toward bacterial bioelectric signal transduction (Joe Larkin and colleagues from

Boston University), and finally, Potential roles for gamma-aminobutyric acid (GABA) signaling in bacterial communities (Arthur Prindle and colleagues from Northwestern University). We are delighted also to include a topical 'My Experiments in Bioelectricity (MEB)' perspective by Joel Kralj in the BioFrontiers Institute at the University of Colorado Boulder. This article recounts, in a personal setting, Dr Kralj's pioneering scientific research in bacterial electrophysiology, includes crossing paths with many other pioneers in the field and outlines future perspectives and current collaborations in the development of novel optical electrophysiology approaches.

There is no doubt that the field of microbial electrophysiology will continue to flourish. Exciting future areas of development include: single-cell bacterial electrophysiology, microbial community electrophysiology, synthetic biology, bioengineering, tool development and measurement technologies for bacterial and microbial eukaryotic electrophysiology, electrochemical impacts of metabolism, and the electrochemical basis of plant-microbe and host-microbe interactions. In addition, bacterial ion channels will continue to serve as models for their mammalian counterparts. Although interdisciplinarity is increasing across all research arenas, this Special Issue demonstrates clearly that innovations in the field of bacterial electrophysiology inherently integrate techniques and technologies drawn from medicine, computer science, physics, biology, chemistry, materials science and genetics (and others). Further developments will be highlighted in a symposium that we are organizing in the fall meeting of the Materials Research Society which the bioelectricity community might like to be aware of. The title is "Photo/Electrical Phenomena at the interface with living cells and bacteria" (https://www.mrs.org/meetings-events/fall-meetings-exhibits/2021-mrs-fall-meeting/call-for-papers/detail/2021_mrs_fall_meeting/sb11/Symposium_SB11). We are excited about the renaissance in bioelectricity research and we look forward to publishing many more breakthroughs in the future.

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