MOTOTRANS: Light-driven molecular motors to trigger transmembrane transport of anions

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Biography

After obtaining his BSc (2016) in Chemistry from the University of Calcutta, West Bengal, India, Abhishek joined the Indian Institute of Science Education and Research (IISER), Pune, to pursue an integrated MS-PhD in the same year. He was awarded the prestigious Prime Minister's Research Fellowship to carry out his PhD under the supervision of Prof. Pinaki Talukdar, where he worked on developing artificial anion and water transport systems and evaluating their biological activity. In July, 2023, Abhishek joined the Wezenberg group as a postdoctoral researcher to work on molecular machine based artificial anion transport systems.

Abstract

Ion transport across cellular membranes, facilitated by specialized transport proteins, stands as a pivotal process within biological systems. Recent strides have seen the emergence of synthetic transmembrane anion transporters. Unlike their protein counterparts, these synthetics often lack responsive characteristics, rendering their function indiscriminate. Presently, only a handful of techniques exist for modulating their transport capabilities through physiochemical stimuli, with light manipulation being particularly notable. Nonetheless, these stimuli-responsive constructs merely toggle between discrete "on" and "off" states, contrasting the nuanced control observed in natural biomolecular arrangements, where motor proteins orchestrate ion passage. Initial investigations suggest that rotating molecular motors may augment cation transport via membrane-spanning channels, potentially impacting conformational dynamics. Yet, comprehensive explorations into leveraging subtle membrane alterations remain scarce. The prospect of integrating molecular machine analogues into lipid bilayers and synthetic transport systems holds great promise for enhancing and regulating anion transport across membranes. MOTOTRANS, a multidisciplinary initiative, endeavours to pioneer transmembrane anion transport systems featuring light-driven molecular motors. Leveraging the non-equilibrium rotational dynamics of these motors could intricately influence membrane, carrier, or channel properties, thereby bolstering transport activity.