Mechanistic understanding and reverse engineering of ion channels: from fundamental science to nanotechnology

Armagan Kocer
Faculty of Science and Technology
Department of Bioelectric
Signaling and Engineering
University of Twente
a.kocer@utwente.nl

Ion channels are pore-forming transmembrane proteins present in all kingdoms of life. They sense chemical, biological, or mechanical stimuli and convert them into electrical signals by regulating the movement of ions across the otherwise impermeable biological membranes. In excitable cells, such as neurons and muscles, ion channels are responsible for efficient and fast electrical communication. Defects in ion channel functioning have significant physiological and behavioral effects. With the current advances in science and technology, we are now at a stage to understand ion channels' the working mechanisms and engineer new functions on ion channels to perform biological or non-biological tasks.

In my talk, I will present:
1. Our molecular tools to study and manipulate ion channels in their detergent-solubilized form, liposomes, cells, and vacuum environment[1–3] by exploring the wetting-dewetting of nanoconfinements,
2. Findings on the working mechanism of a mechanosensitive ion channel at the molecular level[4–7],
3. Two direct applications of our engineered ion channels in the fields of nanomedicine and biosensors, especially on targeted and triggered drug delivery and early disease diagnosis[8–10].

References

[1] Kocer, A. Science. **309**, 755 (2005).
[2] Koçer, A. et al. Angew. Chemie - Int. Ed. 45, 3126 (2006).
[3] Konijnenberg, A. *et al.* Proc. Natl. Acad. Sci. U. S. A. **111,** 17170 (2014).
[4] Birkner, J. P., Poolman, B. & Koçer, A. Hydrophobic gating of mechanosensitive channel of large conductance evidenced by single-subunit resolution. Proc. Natl. Acad. Sci. U. S. A. **109,** 12944 (2012).
[5] Mukherjee, N. *et al.* FASEB J. **28,** 4292 (2014).
[6] Mukherjee, N. *et al.* FASEB J. **28,** 4292 (2014).
[7] Mika, J. T., Birkner, J. P., Poolman, B. & Koçer, A. FASEB J. **27,** 882 (2013).
[8] Halža, E., Bro, T. H., Bilenberg, B. & Koçer, A. Anal. Chem. **85,** 811 (2013).
[9] Pacheco-Torres, J. et al. Nanomedicine Nanotechnology, Biol. Med. 11, 1345 (2015).
[10] Urban, M. et al. Nano Lett. 14, 1674 (2014).