Important notes:

Do **NOT** write outside the grey boxes. Any text or images outside the boxes **will** be deleted.

Do **NOT** alter the structure of this form. Simply enter your information into the boxes. The form will be automatically processed – if you alter its structure your submission will not be processed correctly.

Do not include keywords – you can add them when you submit the abstract online.

Title:

Oriented 2D covalent organic framework membranes for nanofluidic ion transport

Authors & affiliations:

Please do not include Personal Data (email address, postal address, etc.) in this field. Include only author names & affiliations

Li Cao[1], Zhiping Lai[1]*

[1]King Abdullah University of Science and Technology (KAUST), Saudi Arabia

Abstract: (Your abstract must use **Normal style** and must fit in this box. Your abstract should be no longer than 300 words. The box will 'expand' over 2 pages as you add text/diagrams into it.)

Preparation of Your Abstract

1. The title should be as brief as possible but long enough to indicate clearly the nature of the study. Capitalise the first letter of the first word ONLY (place names excluded). No full stop at the end.
2. Abstracts should state briefly and clearly the purpose, methods, results and conclusions of the work.

Introduction: Clearly state the purpose of the abstract
Methods: Describe your selection of observations or experimental subjects clearly
Results: Present your results in a logical sequence in text, tables and illustrations
Discussion: Emphasize new and important aspects of the study and conclusions that are drawn from them

Biological ion channels play a significant role in fundamental physiological functions of living organisms, by regulating ion transport under environmental stimuli, such as pH, voltage, and concentration gradients. However, it remains a long-standing challenge to fabricate high-efficiency ion-permselective nanofluidic membranes with high ion flux, efficient ion selectivity, and smart ion gating capabilities.

Two-dimensional (2D) covalent organic frameworks (COFs) are a class of crystalline porous materials assembled using molecular building units featuring predetermined and atomically ordered channel architectures. In regard to nanofluidic ion transport, the modular nature of COFs enables the customized construction of ion channels with tunable size and topological structure. Their diverse organic units and rich chemistry also allow for the modification of their channel surface properties and by extension, their response to external stimuli. Furthermore, the oriented 2D COF membranes usually have vertically aligned channel arrays, which is particularly attractive for nanofluidic ion transport and osmotic energy conversion. Herein, we report the fabrication of large-area, highly crystalline, and oriented 2D COF membranes that achieve unprecedentedly massive and vertically-oriented nanofluidic channels, capable of yielding 2-3 orders of magnitude higher ion currents than those in conventional nanofluidic systems. A surface-charge-governed ion conductance is predominantly observed for electrolyte concentrations up to 0.01 M, further revealing the great potential of our proposed oriented 2D COF membranes as nanofluidic devices. These high ion-flux and smart gating nanofluidic features possess significant implications in biomolecule manipulation and energy conversion applications.

In conclusion, our proposed oriented 2D COF membranes are prospected to provide with an ideal platform to fabricate smart nanofluidic devices for studying the mechanisms underlying ion/molecular transport. This work also demonstrates the great potential of ultrathin, oriented 2D COF membranes in energy-related applications including osmotic energy harvesting, redox flow batteries, electrochemical reactors, and other molecule/ion-selective transport processes such as electrodialysis and desalination.