Keynote lecture: Boston, MA, April 18-20, 2022

Materials-2022

Progress in water desalination using all-carbon membranes

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Abstract:

Whereas water itself is bountiful on Earth, much of it requires treatment to make it suitable for human consumption. Lack of potable water is currently the leading cause of death, ahead of any disease. Recent progress in fabricating nanostructured carbon allotropes may bring a long-awaited paradigm shift in designing membranes that would make efficient desalination of salt water using reverse osmosis and filtration of contaminated water possible. A previously unexplored membrane design [1] based on a unique layered assembly of carbon nanostructures including graphite oxide (GO), buckypaper consisting of carbon nanotubes, and a strong carbon fabric should provide high mechanical strength and thermal stability, resilience to harsh chemical cleaning agents and electrical conductivity, thus addressing major shortcomings of commercial reverse osmosis membranes. Microscopic insight into the critical permeation of water molecules in-between GO layers and across in-layer vacancy defects in graphitic carbon can be obtained using *ab initio* density functional theory calculations. Results of these computational studies elucidate the reason for selective rejection of solvated Na^+ ions in an optimized layered all-carbon membrane.

References

[1] David Tománek and Andrii Kyrylchuk, Designing an All-Carbon Membrane for Water Desalination, Phys. Rev. Applied **12**, 024054 (2019).

Biography:

David Tománek is a U.S.-Swiss physicist of Czech origin and researcher in nanoscience and nanotechnology. He is Emeritus Professor of Physics at Michigan State University. He is known for predicting the structure and electronic properties of surfaces, atomic clusters, nanotubes, nanowires and graphene, and two-dimensional materials including phosphorene. His current focus is water desalination. He initiated a series of Nanotube (NT) conferences and a Gordon Research Conference on *Two-dimensional electronics beyond graphene.* He is a Fellow of the American Physical Society, recipient of the Alexander-von-Humboldt Senior Scientist Award in Germany and the Carbon Award for Life-Time Achievement in Japan.