Giant thermoelectric response of nanofluidic systems

Li Fu*[1], Laurent Joly[1], and Samy Merabia[1]

[1]Institut Lumière Matière (ILM) – CNRS : UMR5306, Université Claude Bernard - Lyon I (UCBL) – UMR5306 CNRS Université Claude Bernard Lyon 1 Domaine Scientifique de La Doua Bâtiment Kastler, 10 rue Ada Byron 69622 Villeurbanne CEDEX, France, France

Abstract

Nanofluidic systems could in principle be used to produce electricity from waste heat, but current theoretical descriptions predict a rather poor performance as compared to thermoelectric solid materials. Here we investigate the thermoelectric response of NaCl and NaI solutions confined between charged walls, using molecular dynamics simulations. We measure a giant thermoelectric response, two orders of magnitude larger than the predictions of standard models. We show that water excess enthalpy – neglected in the standard picture – plays a dominant role in combination with the electroosmotic mobility of the liquid-solid interface. Accordingly, the thermoelectric response can be boosted using surfaces with large hydrodynamic slip. Overall, the heat harvesting performance of the model systems considered here is comparable to that of the best thermoelectric materials, and the fundamental insight provided by MD suggests guidelines to further optimize the performance, opening the way to recycle waste heat using nanofluidic devices.

*Speaker