Water-Evaporation-Induced Electric Generator (WEIG) Built from Carbonized Electrospun Polyacrylonitrile Nanofiber Mats

With the increasing demand for clean, sustainable, and renewable energy over the past few decades, researchers have made significant efforts to develop efficient technologies that can harvest renewable energy resources. Recently, the capillary rise of water through nanochannels of porous membranes has been used for generating electricity from water. Upon contact with water, the surface functionalities in the porous membrane undergo ionization and form an electric double layer at the interface. Water flow in channels with a charged surface carries along the counterions, producing a net charge transport known as the streaming current. Meanwhile, the induced electric field along the flow gives rise to a streaming potential. If a porous membrane is partially submerged in water, water flow can be caused by capillary action. While the risen water evaporates from the unsubmerged end, fresh water is transported from the submerged end to replenish the evaporated water. The streaming current and potential from this continuous water rising can be harnessed via a water-evaporation-induced generator (WEIG).

Different WEIGs have been reported; however, there are limitations associated with the hydrovoltaic materials investigated to date. For example, although various porous carbon materials have been exploited to fabricate WEIGs, these materials are not necessarily easy to handle and require some form of solid support as the substrate. Furthermore, reported WEIGs possess low energy densities that limit their applicability.

This seminar will introduce a novel free-standing porous carbon nanofiber mat for constructing WEIGs that may be 10,000 times more powerful than the traditional ones. It will also provide a report on the fabrication process of polyacrylonitrile (PAN)-derived carbon nanofiber mat WEIGs, performance improvement, as well as the operating principles of these WEIGs in Milli-Q water and salt solutions.