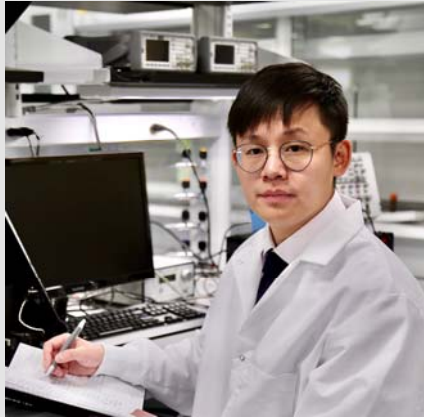


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Dr. Jun Liu

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MECHANICS AND MATERIALS FOR TRIBO-TUNNELING ENERGY HARVESTING

ABSTRACT

The direct conversion of mechanical energy into electricity by advanced material-based devices offers unprecedented opportunities for self-powered electronics, robotics, sensors, implants, and potential energy solutions for aerospace missions. A conventional piezoelectric or triboelectric nanogenerator converts frictional energy into electricity by producing alternating current (AC) triboelectricity. However, extremely low current densities attainable with these approaches impose severe limitations on their practical applications. In this talk, I will introduce a concept of tribo-tunneling direct-current (DC) transport [1-3]. Sliding frictional metal-semiconductor interfaces have been demonstrated to generate high current density on the order of 100 A/m² by quantum mechanical tunneling. We have observed that the illumination of frictional contact can increase the output power through a tribo-photovoltaic effect [4]. Efforts towards scaling up the output power are presently underway offering opportunities for integrated solutions for power generation and storage. [5-6] I will discuss the roles and opportunities for advanced materials and engineered interfaces (semiconductor materials, 2D materials, phase-transition materials, etc.) in integrated energy solutions involving generation, storage, and transmission. I will also address the challenges in translating these mechanical energy harvesting technologies for immediate industrial and commercial applications.

References:

[1] J. Liu, et al, *Nature Nanotechnology*, 2018, 13 (2), 112; [2] J. Liu, et al, *Materials Horizons*, 2019, (6), 1020; [3] J. Liu, et al, *Nano Energy*, 2018, 48, 320-326; [4] J. Liu, et al, *Matter*, 2019, 1 (3), 650-660; [5] J. Liu, et al, *Advanced Electronic Materials*, 2019, 1900464; [6] J. Liu, et al, *ACS Applied Materials & Interfaces*, 2019, 11,38, 35404-35409

BIO SKETCH

Dr. Jun Liu is currently a Postdoctoral Research Associate in the Department of Chemical and Biological Engineering at the University at Buffalo, The State University of New York. Prior to joining UB, he earned his PhD in Materials Engineering from the University of Alberta, Canada in 2018. Dr. Liu is the pioneer of tribo-tunneling and tribo-photovoltaic nanogenerator, with 24 refereed publications, 1 US provisional patent, and 4 invention disclosures. The industrialization of his technology has been supported by the NSF I-corp program. Dr. Liu is also the Review Editor of *Frontiers of Chemistry*, and has been invited for talk in many professional conferences such as MRS, SPIE, and NENS. His multidisciplinary work has been highlighted in CBC News, Phys.org, ScienceDaily, etc. Jun is the recipient of the Alberta Innovates-Technology Futures (AITF) Graduate Student Scholarship (Canadian Government), Outstanding Graduate Student Overseas (Chinese Government), Best Scientific Research Award in 2019 US Nanosymposium on Scanning Probe Microscopy (SPM), and Second Prize in International Contest of Applications in Nano/Micro Technology. Dr. Liu is passionate about understanding and manipulating fundamental physics at dynamic materials interfaces, and using that knowledge for developing new energy harvesting/storage/transmission technologies.



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