Department of Biomedical Engineering

Research Student Seminar Series

(Supervised by Prof. Lixin DONG)

Operando multi-physical characterization using nanorobotic manipulation with a picometer-scale positioning resolution

Mr. Wenqi ZHANG
Ph.D. candidate

Date:	5 July, 2024
Time:	5:00pm-5:30pm
Venue:	B6619 Conference Room, 6/F, Blue Zone, Yeung Kin Man Academic Building

Abstract

The resolution of positioning and the availability of diverse testing environments are pivotal for nanorobotic manipulation (NRM) at small scales. The former involves the measurement of length-related physical quantities, such as velocity based on displacement, forces based on deformation, and electrostatic fields based on range. The latter ensures alignment between rudimentary experiments and actual working conditions. Piezoelectric-ceramic-based manipulators, widely used by

NRM inside electron microscopes, are expected to provide sub-nano level positioning resolution. However, practical experiments reveal limitations in achieving this spectacular resolution due to microscopes' capability in dynamic length sensing. Here, we propose an NRM system with ultrafine positioning resolution for operando characterization inside a spherical aberration correction transmission electron microscope (Cs-TEM). The Cs-TEM, with sub-angstrom precision in length sensing, demonstrated the ability to achieve picometer-scale positioning resolution of the lead zirconate titanate (PZT)-based manipulator (204 pm, 171 pm, and 140 pm in X, Y, and Z directions). Moreover, the system's compatibility with in-situ chips and optical fibers allows the integration of multi-physical stimuli, such as electrical, thermal, optical, liquid, and magnetic, into the confined chamber of Cs-TEM. This NRM system establishes a versatile platform for operando characterization, facilitating the investigation of performance-mechanism correlations and enabling device-level prototyping.

Biography

Wenqi Zhang is now pursuing a Ph.D. degree in Prof. Lixin Dong's group with the Department of Biomedical Engineering, City University of Hong Kong. His research interests include field-induced nanorobotic manipulation and in-situ ionic device prototyping.

All are Welcome!

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