“Tackling Disease-Associated Biomolecules: From RNA Therapeutics to Single-Molecule Detection”

Wednesday
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3:30 p.m.
Wu and Chen Auditorium

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Abstract

The functionality versatility of polymeric and nucleic acid materials provides diverse engineering opportunities for the detection and therapeutic targeting of disease-associated biomolecules. My work has encompassed nanoscale and microscale technologies to address challenges in cancer therapeutics and diagnostics, from targeting the expression of dysregulated genes to probing rare protein biomarkers. I will first describe the design of a highly potent small interfering RNA nanoparticle delivery system that leverages approaches in nucleic acid engineering and polymer chemistry. Towards overcoming analytical barriers in clinical diagnostics, I will then describe the development of ultrasensitive single-molecule detection technologies to measure low abundance proteins. By utilizing powerful molecular amplification methods and simple signal readouts, these digital enzyme-linked immunosorbent assay (ELISA) platforms enable the detection of low attomolar (10^{-18} M) protein concentrations, with over four orders-of-magnitude improvements in sensitivity over conventional protein detection methods. Importantly, these methods democratize ultrasensitive protein detection, enabling high-throughput, high-multiplex digital measurements to be carried out with common laboratory instrumentation.

Finally, I will highlight the application of digital ELISA technology towards the development of an ultrasensitive blood test for a retrotransposon-encoded protein as a highly specific multi-cancer biomarker. Overall, the development of these technologies can pave the way towards the future integration of materials and biomolecular engineering approaches with ultrasensitive bioanalytical tools for accelerating biomarker signature discovery and precision medicine.

Bio

Connie Wu is an NIH F32 Ruth L. Kirschstein postdoctoral research fellow in Dr. David Walt's lab at Brigham and Women's Hospital and the Wyss Institute for Biologically Inspired Engineering at Harvard University. She obtained her B.S. in chemical engineering from Yale University, where she worked with Dr. Paul Van Tassel in designing porous layer-by-layer polymer films for tissue engineering applications and received a Barry M. Goldwater Scholarship. Connie pursued her Ph.D. in chemical engineering at MIT, working in Dr. Paula Hammond's lab on polymer-based RNA interference delivery systems for cancer therapeutics. She was the recipient of multiple fellowships during her Ph.D. training, including an NSF Graduate Research Fellowship, Ludwig Center for Molecular Oncology Graduate Fellowship, and MIT Presidential Fellowship. In her current postdoctoral work, Connie has developed ultrasensitive single-molecule detection platforms for biomarker discovery and diagnostic applications.

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