Mechanically Functional DNA Nano-devices to Probe and Actuate Cellular Machinery

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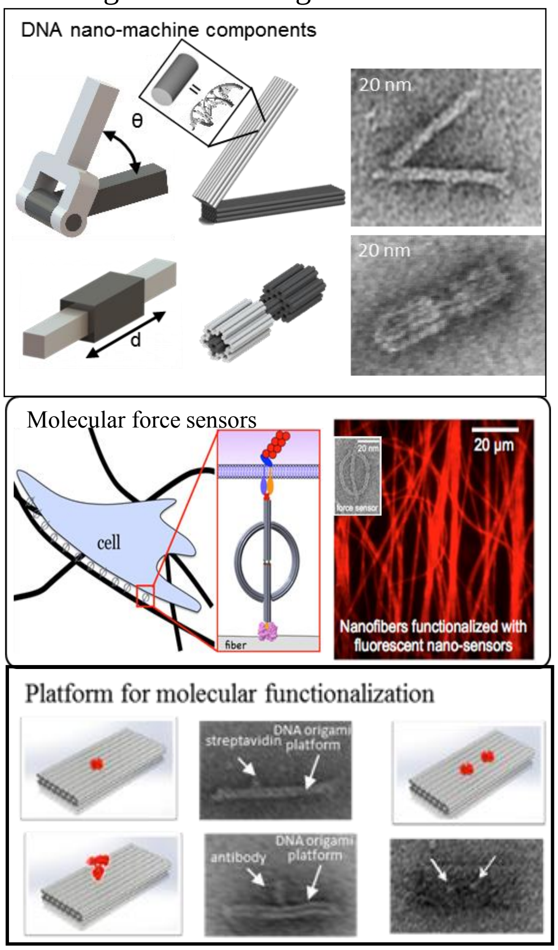
Directly probing biomolecular machinery in the context of cellular function can enable novel insight into the molecular mechanisms that regulate cellular processes. Devices that are fabricated at a similar length scale to the biomolecular systems of interest provide a unique advantage of examining function in a wide range of experimental assays including studying cells or biomolecules in environments similar to in vivo conditions. Researchers in the Automated Cell to Biomolecule Analysis (ACBA) platform team have made critical progress towards developing a panel of devices designed to probe physical and chemical interactions of biomolecules. These devices are assembled using a recently developed DNA-based self-assembly approach termed DNA origami nanotechnology. In particular, our results have led to novel approaches to create DNA-based nanodevices with mechanical functionality, including actuated moving parts and deformable components with tunable stiffness.



Current state-of-the-art tools to probe physical behaviors of biomolecular machinery in the context of cellular function include force spectroscopy approaches, such as atomic force microscopy, which enable application and/or measurement of forces but require cumbersome instrumentation and experimental assays that are generally not well-suited for physiological environments (i.e. fibrous matrices). Furthermore, resolving dynamic behavior in the ~10-100nm range, where many important molecular processes occur, is highly challenging. Mechanically functional DNA-based devices with dimensions in the 10-100nm range can open the door to investigating physical processes or actuating machinery of biomolecular complexes to understand or manipulate cellular processes, such as cell migration, with mechanical readouts or inputs.

This work will broaden the scope of DNA nanotechnology and has the potential to provide a set of robust nanodevices that can be applied in physiological cellular environments, such as fibrous matrices. In addition, the dimensions of these devices are on the size scale such that they could be directly injected into cells to study biomolecule function in native environments.

For further information about this project link to **https://mae.osu.edu/labs/nbl/** or email **castro.39@osu.edu**.