Molecular Biomotors – Insights from in-vitro Investigations

Winfried Teizer

Department of Physics and Astronomy
Director, Center for Nanoscale Science and Technology
Texas A&M University, USA

Nature has generated sophisticated and very efficient molecular motors, employed for nanoscale transport at the intracellular level. As a complementary tool to nanofluidics, these motors have been envisioned for nanotechnological devices. In order to pave the way for such applications, a deeper understanding of the mechanisms governing these motors is needed. Because of the complexity of their in-vivo functions, this understanding is best acquired in-vitro, where functional parameters can independently be controlled. I will report on work in my group that studies and harnesses the transport properties of molecular biomotors on functionalized structures of reduced dimensionality, such as carbon nanotubes,[1] lithographically designed electrodes,[2] microwires,[3] loops,[4] and swarms.[5] In addition, I will show results that demonstrate the potential of this work for biomedical advances.[6]

Keywords: molecular biomotors, carbon nanotubes, motor proteins, patterning.

References

[1] *Molecular Motor-Powered Shuttles along Multi-walled Carbon Nanotube Tracks*. A. Sikora et al., Nano Lett. **14**, 876 (2014). *Microtubule guiding in a multi-walled carbon nanotube circuit.* A. Sikora et al., Biomed. Microdevices **17**, 4 (2015).

[2] *Surface Manipulation of Microtubules Using Self-Assembled Monolayers and Electrophoresis*. J. A. Noel et al., ACS Nano **3**, 1938 (2009).

[3] *Microtubule shuttles on kinesin-coated glass micro-wire tracks*. K. Kim et al. Biomed. Microdev., **16**, 501 (2014). *Functional Localization of a Kinesin/Microtubule-Based Motility System along Metallic Glass Microwires*. K. Kim et al. Appl. Phys. Lett. **105**, 143701 (2014).

[4] *Behavior of kinesin driven quantum dots trapped in a microtubule loop*. A. Sikora, et al., ACS Nano **9**, 11003 (2015).

[5] *Large-scale chirality emerging from an active layer of microtubules and kinesin motor proteins*. K. Kim, N. Yoshinaga, S. Bhattacharyya, and W. Teizer. **S**oft Matter **14**, 3221 (2018).

[6] *Restoring the Processivity of Kinesin Nanomotors*. S. Bhattacharyya, K. Kim, and W. Teizer. Adv. Biosys. **1**, 1600034 (2017). *Remodeling Tau and Prion Proteins Using Gold Nanoparticles*. S. Bhattacharyya, K. Kim, and W. Teizer. Adv. Biosys. **1**, 1700108 (2017). *Nanoparticle Assisted Editing of Proteotoxic SOD 1 Mutants Alters the Biointerface of the Functional Interaction of Microtubules and Kinesin Motors*. K. Kim, S. Subramaniyam, A. Galaleldeen, H. Nakazawa, M. Umetsu, W. Teizer, S. Bhattacharyya. ACS Appl. Bio Mater. **2**, 10, 4121 (2019).