Progress Towards Time-Resolved non-contact Atomic Force Microscopy for Study of Two-Dimensional Organic Conjugated Polymers

E. Ulyanov,[1,#] W. Behn,[1] S. Briesenick,[1] D. Jacob,[1] D. Perepichka,[2] and P. Grutter[1]

[1]*Department of Physics, McGill University, Montréal, Québec, H3A 2T8, Canada*
[2]*Department of Chemistry, McGill University, Montreal, H3A OD8, Canada*

Presenting author's e-mail: ekaterina.ulyanov@mail.mcgill.ca

Two-dimensional organic conjugated polymers (2DCPs) are promising candidates to combine suitable band structure with high carrier mobility.[1] Large-scale, highly ordered growths are required for applications including photovoltaics, energy storage, and organic nanoelectronics. We have performed a series of direct polymerization growths via surface-assisted Ullmann coupling with tribromo- and triiodotrioxaazatriangulene (TBTANG and TITANG).[2,3] Using scanning tunneling microscopy (STM) and non-contact atomic force microscopy (nc-AFM) under low-temperature (10 K), ultra-high vacuum (UHV) conditions, we then quantified the film quality, including the prevalence of undesired organometallic intermediates and non-hexagonal lattice defects. This technique may be expanded to copolymer heterostructures, composed of TBTANG and tribromotrioxoazatriangulene (TBTANGO), as well as to new chemical precursors. Specifically, our next steps include growing films using C-centered trioxotriangulene precursors, predicted to have interesting magnetic properties due to their radical spins.[4,5] To study these properties, we are working towards combining the high spatial resolution of the STM/AFM system with the time resolution of an ultrafast (10 femtosecond) pulsed laser. We will use pump-probe techniques to document and characterize the time evolution of the polymers' optoelectronic properties—including charge mobility and exciton/polaron formation—towards the long-term goal of realizing organic nanoelectronics.[6]

References

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