TEXAS TECH UNIVERSITY
Department of Mechanical Engineering

Multi-scale Graphene Structures for Advanced Bio-Interfaces

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Abstract: Superb electromechanical properties of graphene, where large elastic deformation is achievable without significant perturbation of electrical properties, provide a substantial promise for flexible electronics, advanced nanoelectromechanical and bioelectronic devices. We report three-dimensional (3D) field-effect transistor biosensors built from the monolithic integration of crumpled graphene and graphite. First, we present monolithic synthesis of graphene-graphite for all-carbon bioelectronic transistor arrays. Second, we develop a rapid and scalable method of texturing 2-dimensional (2D) graphene by using soft-matter transformation of shape-memory polymers into 3D bioelectronic sensors. We demonstrate that the thermally-induced transformation of graphene on a polymeric substrate creates 3D textured graphene. We further characterize the electrical and mechanical properties of 3D graphene, and demonstrate the robust electromechanical properties of 3D textured graphene. Finally, we explore biosensor device applications by constructing an array of field-effect biosensors and interfacing with muscle and cardiac cells for 3D nano-electrophysiology. We believe our approach to forming textured graphene by soft-matter transformation offers a unique avenue for creating advanced and 3D bioelectronic devices, and furthermore, these unique capabilities could be exploited in chemical and biological detection and conformal interface with biological systems in the future.

Bio: Dr. SungWoo Nam is an Assistant Professor in the Department of Mechanical Science and Engineering at University of Illinois at Urbana-Champaign (UIUC). He received a B.S. degree in Materials Science and Engineering from Seoul National University, South Korea, where he graduated summa cum laude with the Valedictorian Prize, ranked 1st in the School of Engineering. Following three years of industry experience in carbon nanotube technology (ILJIN Nanotech Co., Ltd.), he obtained his M.A. in Physics (2007) and Ph.D. in Applied Physics (2011) from Harvard University. Following the completion of his Ph.D., he worked as a postdoctoral scholar at the Department of Bioengineering of the University of California, Berkeley. His current research interest at UIUC include (1) investigating new synthesis/assembly methods of nano-materials for advanced functions, and (2) bridging nano-materials/devices and biological systems to enable new opportunities for quantitative biology in

their natural 3-dimensional (3D) forms. Dr. Nam has published peer reviewed papers in journals such as Nature, Nature Materials, Nano Letters, and PNAS, and has given more than 30 invited lectures. Dr. Nam was the recipient of the KSEA Young Investigator Grant (2014), Doctoral New Investigator Award of the American Chemical Society (ACS) Petroleum Research Fund (2013), UIUC Engineering Council Award for Excellence in Advising (2013).

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Livermore Center 101 | 2:00 – 3:00 pm
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