3D-PRINTED ELECTRONICS WITH NANOMATERIALS. Daeha, Joung. Department of Physics, Virginia Commonwealth University. To interface functional devices with biological counterparts, there arises a need to generate artificial 3D structured materials or heterogeneously integrated functional devices across various scales. While conventional fabrication methods have facilitated the development of 2D networks for interfacing with biology, they face limitations when applied to complex 3D geometries demanding hierarchical precision and multi-material complexity. Our approach centers on harnessing an extrusion-based multi-material 3D printing, an additive manufacturing technology enabling versatile and self-guided fabrication. Through the harmonious integration of multi-material 3D printing and meticulous design, we can enhance the sensitivity, durability, and adaptability of printed devices, ultimately enhancing their operational capabilities and overall performance. We explore the application of flexible and stretchable one-component carbon nanotube (CNT)/silicone conductive inks. Through this application, we have achieved the successful creation of self-supporting microstructures on both polar and non-polar flexible substrates. This achievement allows for seamless and unobtrusive monitoring of physiological health. Additionally, our introduction of graphene/polycaprolactone (PCL) hair-like mechanosensors has brought about a groundbreaking inter-hair contact sensing mechanism. This innovation transforms the sensor into an intuitive on-off switch, substantially amplifying sensitivity while minimizing uncertainty in detection. These strides collectively align with our overarching objective of improving healthcare outcomes, driving forward biomedical research, and fostering the evolution of personalized medicine. Author contact: joungd2@vcu.edu