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From Nano-Particle to Macro-Impact: Nanopartical-Decorated 3D Carbon Scaffolds

D. Bruce Burckel

Nanoparticles exhibit a wide array of interesting physical behaviors that are not observed in bulk materials. Surface enhanced Raman scattering, localized surface plasmon resonances and tunable emission from semiconducting quantum dots are all examples where the behavior of the particle is dramatically influenced by its size. One of the challenges to translating these interesting nano-particle behaviors into macroscopically measurable effects is establishing a platform for interacting with the nano-particle system on the micrometer and larger scales where conventional laboratory equipment can be used.

Recently, we have demonstrated that we can convert 2D/3D resist structures created using interferometric lithography into amorphous sp2 and sp3 bonded carbon via pyrolysis in a reducing atmosphere (Fig. 1A). These structures maintain their basic pattern morphology despite undergoing significant shrinkage. The carbon scaffolds are rugged, and readily modifiable with a wide range of functional thin film and nano-particles. Furthermore, the decorated structures exhibit behaviors that can be attributed to the material characteristics of the carbon, the type and morphology of the nano-particle and the hierarchical structuring of the carbon scaffold.

In this talk I will discuss the fabrication of these structures, their application to several sensing modalities and potential energy storage and harvesting applications where these unique structures offer unique benefits.

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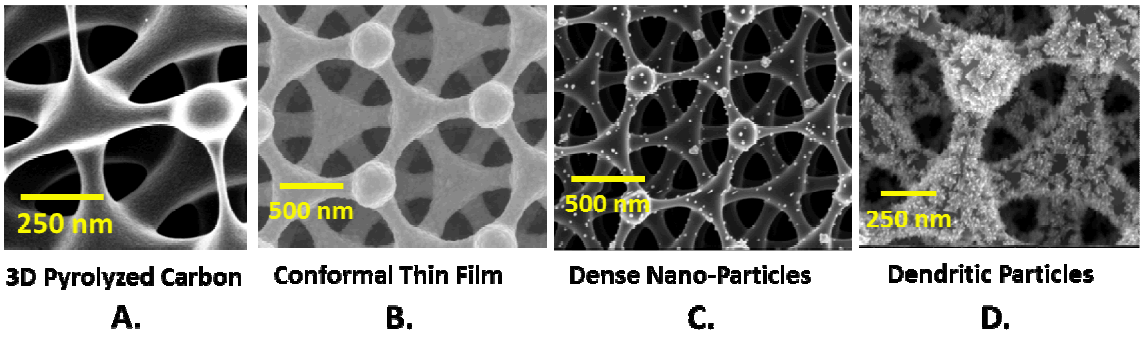

Figure 1. 3-D Metallic SRRs created using membrane projection lithography.