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3D-Printed Graphene-Based Aerogel Electrodes for Energy-Related Applications

Aerogels are monolithic high surface area structures with great potential as electrodes for a number of energy-related applications like energy storage (e.g. supercapacitors, redox flow batteries, Li-ion batteries, etc.), and energy conversion (e.g. hydrogen evolution, oxygen reduction, etc.). However, the random, uncontrolled nature of their porous networks can hinder mass transport and negatively impact device performance. 3D printing provides a means to synthesize aerogels in a manner that can mitigate the mass transport issues by intelligently incorporating macroporous channels into the native nanoporous aerogel structure. This advance in electrode fabrication has the potential to provide an even greater level performance for these hierarchical functional materials. Here we present our recent efforts to 3D print aerogel materials. The 3D printed aerogels exhibit many of the same properties as bulk aerogels, but with some enhancements in mass transport as well as mechanical properties. Energy storage devices based on 3D printed electrodes, which exhibit great rate capability, synergistic capacity, and cycling stability, will be presented.

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References

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Figures

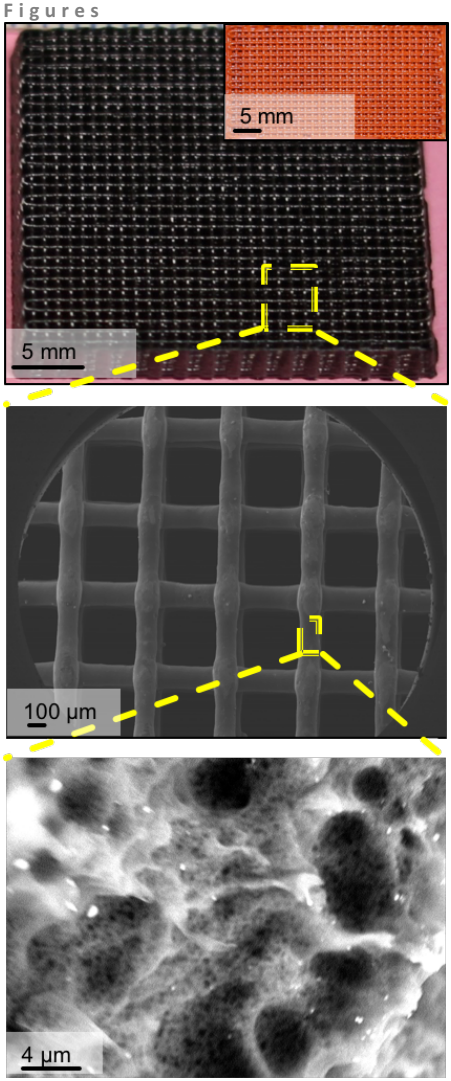

Figure 1: Photograph (top), low magnification (middle), and high magnification (bottom) SEM of 3D-printed carbon aerogel. Inset shows 3D-printed aerogel before carbonization.