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Amorphous Carbon Aerogels from Xerogel Powders

Carbon aerogels are well known for their high surface areas and high porosities. Their applications have been demonstrated in a wide range of areas such as CO2 capture, electrodes for electrochemical cells, etc. They are typically made from pyrolysis of carbonizable polymeric aerogels, which in turn are synthesized via sol-gel methods. Preparation of those polymeric aerogels involves supercritical fluid drying of wet-gels by replacing the pore-filling solvent with liquid CO2 that can be vented off as a gas, thus allowing pores to retain their shape and size. In contrast, here a new alternative route is proposed for the synthesis of carbon aerogels from xerogel powders, which allows to speed-up the solvent exchange process and bypasses the supercritical fluid drying, resulting in time, energy, and materials efficient methodology for fabricating porous carbons. In this new method, crosslinked silica xerogel powders were prepared via free-radical surface-initiated polymerization of acrylonitrile on the network of silica suspension. Alternatively, cross-linked silica xerogel powders were prepared with a carbonizable polyurea derived from the reaction of an aromatic triisocyanate with different functional groups on the surface of silica suspension. Wet-gel powders were dried under vacuum, compressed into pellets and were then aromatized, pyrolyzed, and treated with HF and/or CO2 to remove SiO2 particles and/or carbon, creating porosity.

Daniel Greenan is a senior studying Chemistry from St. Peters, Missouri. He has been researching carbon aerogels with Dr. Sotiriou-Leventis since the Fall of 2019. In the Summer of 2019, he researched the causes of pyridoxine dependant epilespy with Dr. Gates. Daniel plans to pursue a PhD in Chemistry and to work in industry afterwards. Outside of research, he was involved in the Mars Rover Design Team for two years, and he enjoys spending his free time outside playing basketball or running