



## **TUNABLE NANOPOROUS CARBON FOR EFFICIENT SUPERCAPACITORS**

Porous carbon is employed in a variety of applications such as molecular sieves, catalyst supports, gas storage material, adsorbents, electrodes, capacitive desalination materials, and supercapacitors due to its versatile pore size distribution and wide structure network. Supercapacitors are preferred over conventional batteries due to their durability and effectively enhanced power bursts leading to several research efforts being undertaken to augment the storage capacity of these materials.

Y-Carbon Inc., is a nanoporous carbon manufacturing company based in King of Prussia, PA. This company manufactures exclusive, high-precision and tunable nanoporous carbon having high-specific surface area and large volume. This company holds exclusive intellectual property rights for its tunable nanoporous carbon catering to applications in clean energy, health care, and safe drinking water. Y-Carbon was spun-out of Pennsylvania NanoMaterials Commercialization Center and The Nanotechnology Institute of Ben Franklin Technology in 2004 in South Eastern Pennsylvania.

Y-Carbon used its proprietary Carbide Derived Carbon (CDC) technology, developed by Ranjan Dash, chief technology officer, to prepare tunable nanoporous carbon. This CDC technology involved chemical etching of a metal or a metalloid from an inorganic precursor such as metal halides (silicon carbide for example) in the presence of chlorine gas (used in closed loops) at elevated temperature. This etching process ensures the removal of metals as gaseous metal chlorides thereby providing ample scope for carbon to be rearranged with atomic-level control of porosity creating uniformly distributed porous carbon network.

This CDC technology finds its primary applications in the energy, water, and healthcare industry providing enhanced performance characteristics in each of the industry segments. Dash told Technical Insights that the CDC technology is based on a single-step manufacturing process as compared to the conventional processes thereby making it an energy-efficient process with good control on the material properties. Moreover, the metal chlorides formed in this process exhibit good quality as compared to the conventional metal chlorides thereby creating further opportunities for the metal chlorides market.

The utilization of a dangerous gas such as chlorine in a state-of-the-art closed loop setup was instrumental in ensuring the safety of the process with zero emissions making it a "green" process. In addition, the high quality of the tunable carbon ensured enhanced energy storage characteristics with upto 3 times the ionic liquids

and 2 times the organic electrolytes used conventionally. Furthermore, this technology employs carbon as a high-tech material instead of burning it and polluting the environment by releasing carbon dioxide; coupled with the tunable porosity characteristics has enabled the replacement of conventional activated carbons in many applications.

Y-Carbon's CDC technology is based on an extensive research work carried out for more than 10 years with an exclusive patent licensed from the Drexel University, Pennsylvania and 12 patents pending currently. This technology recently received the R&D Magazine's R&D 100 Award along with Massachusetts Institute of Technology's (MIT) TR35 Award and was listed as one of the companies to be watched by the Eastern Technology Council, USA.

Y-Carbon has also won the US National Science Foundation (NSF) Small Business Innovation Research (SBIR) Phase I grant for scaling up carbon nanomaterials production in a new 2000 square foot facility in Bristol, PA, for a total amount of \$150,000. Dash added, "This funding will be helpful in preparing a continuous process pilot-scale reactor to generate sufficient amount of material for various applications." The rapid scale-up activity of this technology seems to be headed in the right direction taking into account the green manufacturing process employed by this company thereby creating a cost-effective solution.

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