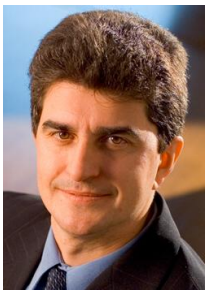
Carbide-Derived Carbons for Energy Related Applications

Yury Gogotsi
Department of Materials Science and Engineering and A.J. Drexel Nanotechnology Institute
Drexel University, Philadelphia, PA 19104
Gogotsi@drexel.edu, http://nano.materials.drexel.edu

Abstract

This seminar will provide an overview of research activities in the area of nanostructured carbon materials at the A.J. Drexel Nanotechnology Institute with focus on supercapacitors and other energy-related applications. Supercapacitors are devices that store electrical energy electrostatically and are used in applications where batteries cannot provide sufficient power or charge-discharge rates. Until now, their higher cost, compared to batteries with similar performance, has been limiting the use of supercapacitors in many household, automotive and other cost-sensitive applications. This presentation describes the material aspects of supercapacitor development, addresses unresolved issues and outlines future research directions.

High surface area carbon materials are widely used as supercapacitor electrodes. Extraction of metals from carbides can generate a broad range of potentially important carbon nanostructures, which range from porous carbon networks to onions and nanotubes. They are known as Carbide-Derived Carbons (CDC). The CDC structure depends on the crystal structure of the carbide precursor as well as process parameters including temperature, time and environment. Extraction of silicon, boron, aluminum, zirconium or titanium from their respective carbides by chlorine at 200-1200°C results in the formation of micro- and mesoporous carbons with the specific surface area up to 3000 m^2/g. CDC technology allows the control of carbon growth on the atomic level, monolayer by monolayer, with a high accuracy. It will be shown that the pore size to ion size ratio determines the efficiency of electrochemical energy storage systems. Design of nanoporous carbons for supercapacitor electrodes, hydrogen and methane storage, fuel cells and other applications will be addressed in this presentation.



Dr. Yury Gogotsi is Distinguished University Professor and Trustee Chair in the Department of Materials Science and Engineering at Drexel University. He also holds courtesy appointments in the Departments of Chemistry and Mechanical Engineering and Mechanics at Drexel University, and serves as Director of the A.J. Drexel Nanotechnology Institute. He served as Associate Dean of the College of Engineering from 2003 to 2007. He received his MS (1984) and PhD (1986) degrees from Kiev Polytechnic and a DSc degree from the Ukrainian Academy of Science in 1995. He has co-authored 2 books, edited 10 books, obtained more than 20 patents and authored about 250 papers. His research has been recognized with S. Somiya Award from the International Union of Materials Research Societies, G.C. Kuczynski Prize from the International Institute for the Science of Sintering, R. Snow Award from the American Ceramic Society (3 times), I.N. Frantsevich Prize from the Ukrainian Academy of Science, R&D 100 Award from R&D Magazine (twice) and two Nano 50™ Awards from NASA Nanotech Briefs. He has been elected a Fellow of the AAAS, Materials Research Society, American Ceramic Society, The Electrochemical Society, as well as Academician of the World Academy of Ceramics and Full Member of the International Institute for the Science of Sintering.