FAST BREAKING PAPERS - 2008

October 2008

PDF

Ji-Huan He talks with *ScienceWatch.com* and answers a few questions about this month's Fast Breaking Paper in the field of Engineering. The author has also sent along images of their work.

Article Title: Electrospun nanoporous spheres with Chinese drug
Authors: Xu, L;He, JH;Liu, Y
Journal: INT J NONLINEAR SCI NUMER SIM
Volume: 8
Issue: 2
Page: 199-202
Year: 2007
* Donghua Univ, Modern Textile Inst, Shanghai 200051, Peoples R China.
(addresses have been truncated)

SW: Why do you think your paper is highly cited?

This paper suggested a new approach, in which a traditional Chinese drug called Yunnan Baiyo is used as an additive, in order to produce nanoporous microspheres by electrospinning, which has always been recognized as an efficient technique for the fabrication of continuous nanofibers. We utilized this technology to produce nanoporous materials, which offer the potential for direct fabrication of biologically based, high-surface-area porous materials without the use of multiple synthetic steps, or postprocessing surface treatments.

SW: Does it describe a new discovery, methodology, or synthesis of knowledge?

Nanoporosity can be controlled by tunable voltage applied in the electrospinning process using the concept of "electrospinning-dilation" (For a detailed explanation, see: Lan Xu, *et al*., "Electrospun Nanoporous Microspheres for Nanotechnology," *International Journal of Electrospun Nanofibers & Applications* 1[2]:105-21, 2007)

SW: Would you summarize the significance of your paper in layman's terms?

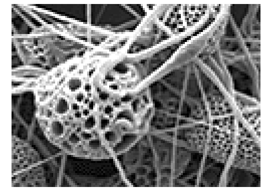
The electrospinning process involves the application of a very high voltage between the spinnerette and the collected plate. A higher applied voltage leads to an elongated cone to overcome the surface tension of the electrospun solution or melt. When it exceeds a threshold voltage, a jet is emanated. During the electrospinning process, the charged jet is accelerated by a constant external electric field, and the spinning velocity probably exceeds the velocity of sound in air for a very short time.

Imagine that the applied voltage was infinitely high, while the distance between the spinnerette and the collected plate was infinitely long, and the velocity would be infinitely large; according to the mass conservation equation, (see He JH, *et al*., "Mathematical models for continuous electrospun nanofibers and electrospun nanoporous microspheres," *Polymer*

International 56 [11]: 1323-29, 2007), the radius of the jet decreases with the increase of the velocity, thus the diameter of the charged jet might become zero! This is, of course, impossible.

Macromolecules of the polymers are compacted together tighter and tighter during the electrospinning process. There must be a critical minimal radius for continuous ultrafine fibers. In cases when the radius of the jet reaches the value of the critical value and the jet speed exceeds its critical value, in order to keep the conservation of mass equation, the jet dilates by decreasing its density, leading to porosity of the electrospun fibers; we call this phenomenon an electrospinning dilation.

Figure 1:



+View larger image & details

SW: Where do you see your research leading in the future?

Electrospun nanofiber technology actually bridges the gap between deterministic laws (Newtonian mechanics) and probabilistic laws (quantum mechanics). One of the most challenging applications of electrospun nanoporous materials is for invisibility devices (e.g., stealth plane, stealth clothes).

SW: Do you foresee any social or political implications for your research?

Because of their ultra-high specific surface, nanoporous structures, which are potentially of great technological interest in the development of electronic, catalytic, and hydrogen-storage systems, invisibility devices, and etc., have received much attention recently.

Pore structure and connectivity determine how microstructured materials perform in applications such as adsorption, separation, filtering, catalysis, fluid storage, and transport, as electrode materials or as reactors. Far-reaching implications are emerging for applications including medical implants and cell supports, materials which can serve as instructive three-dimensional environments for tissue regeneration and other potential uses.

Professor Ji-Huan He
Modern Textile Institute
Donghua University
Shanghai, People's Republic of China

Also see: a featured scientist interview with Ji-Huan He, as well as other features with Ji-Huan He on *ScienceWatch.com*.

Figure 1:

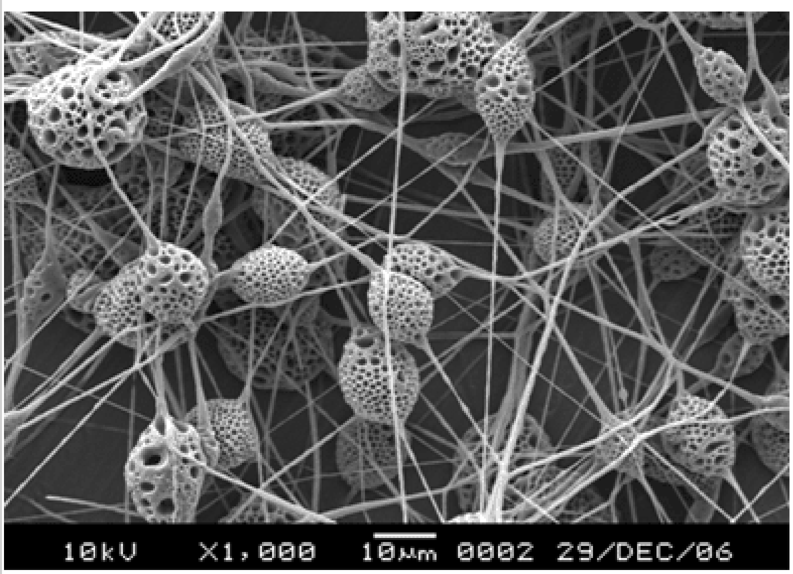


Figure 1:

SEM picture of the electrospun nanoporous microspheres.

Keywords: electrospun nanoporous spheres, Yunnan Baiyo, nanoporous microspheres, electrospinning, efficient techniquee fabrication of continuous nanofibers, nanoporous materials, nanoporosity, tunable voltage,

electrospinning dilation, spinnerette, electrospun solution, macromolecules, polymers, Newtonian mechanics, quantum mechanics, microstructured materials, invisibility devices.

PDF

back to top