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New Ultra-thin Electron Microscopy Windows First To Offer Pure Silicon Composition

SiMPore Inc. has developed an ultra-thin silicon sample preparation support for electron microscopy that is only 5 to 15 nm thick. These new supports are the world's first to be comprised solely of silicon. This unique combination of characteristics substantially increases the precision with which nanotechnology and biomedical researchers can image the intricate details of nanoparticles, nanotubes, proteins or viruses. SiMPore is marketing these new sample supports exclusively through its new online store, TEMwindows.com.

SiMPore's windows for transmission electron microscopy (TEM) represent the first commercial application of a patent-pending membrane technology exclusively licensed to SiMPore by the University of Rochester. The UltraSM® silicon membrane technology is the world's first membrane technology to offer both tunable thickness and tunable pore size. The extreme thinness of UltraSM® TEM windows—less than 50 atoms thick—reduces background interference and improves contrast of TEM images.

UltraSM® TEM windows are available as continuous, amorphous films or as porous, nanocrystalline films. Porous UltraSM® TEM windows contain countless pores of 10-50 nm in diameter. These pores will allow researchers to suspend nanoscale materials across open areas so that the materials can be imaged and analyzed without intervening background. UltraSM® TEM windows are comprised entirely of silicon, allowing them to withstand vigorous plasma and UV-ozone cleaning. Removing contaminants is critical for high-resolution TEM since the presence of contaminants increases sample charging and blurs the images. The pure silicon composition of UltraSM® TEM windows also increases their stability at high beam currents and annealing temperatures—properties necessary for several of today's most demanding TEM techniques.

Christopher Striemer, Vice President of Membrane Development at SiMPore, first discovered the UltraSM® membrane technology while studying silicon thin films at the University of Rochester. His work led to a *Nature* publication in 2007. By

transforming those films into membranes only 15 nm thick, he could more precisely image the intricate crystalline structures of his samples using TEM. Striemer soon realized that other investigators could benefit from this technology if formatted as a TEM window. "These new TEM windows are extremely thin for atomic scale imaging and feature characteristics unique in this market," says Striemer.

Through TEMwindows.com, SiMPore offers a wide variety of UltraSM® TEM windows. The porous TEM windows have an inherent nanocrystalline structure, while the nonporous windows are amorphous and non-crystalline. Each type of window offers distinct advantages over conventional carbon and silicon nitride windows.

Porous UltraSM® TEM windows contain countless nanopores, ranging from 10-50 nm in diameter. These pores permit stable suspension of similarly sized materials, such as protein molecules and carbon nanotubes. "The fact that nanomaterials can be suspended across pores of similar scale and imaged without intervening background will lead to a better physical understanding of nanoscale structures," says Striemer.

Compared to widely used carbon windows, nonporous UltraSM® TEM windows are more consistently thin, circumventing unpredictable variations in a window's thickness that otherwise introduce additional background noise into images.

Striemer also points to the pure silicon composition of UltraSM® TEM windows as offering a number of previously unavailable advantages. "The ability to vigorously clean these new TEM windows with standard plasma cleaning tools will help researchers examine nanostructures at higher resolution without problematic contaminants," says Striemer. Plasma cleaning is simply not possible with carbon windows, which have a carbon film that overlays a copper lattice, as the organic structure of the window itself vaporizes.

Elemental analysis studies by electron diffraction (EDX) or electron energy loss spectroscopy (EELS) of samples containing nitrogen, oxygen and carbon also becomes much simpler when using a pure silicon window since the composition of any background signal will be minimal and immediately distinguishable from the sample. Additionally, UltraSM® TEM windows are electronically stable under high-current electron beams, which arise when trying to obtain high-magnification, high-resolution images of nanostructures using electron microscopy. Silicon impedes an excessive build-up of charge on both the window and the sample, a problem that has consistently plagued research undertaken with traditional windows. Charge build-up often results in degradation of both the window and the sample.

SiMPore is exploring new applications for its UltraSM® membrane technology, including biomolecule and nanoparticle separation, improved hemodialysis, more efficient cell culturing, ion exchange in fuel cells, and micro-fluidic applications on next-generation computer chips. The possibilities are far-reaching, and electron microscopy is only the tip of the iceberg, but nevertheless an avenue that will greatly benefit those doing the latest work in nanotechnology.

"We believe these TEM grids will help those at the forefront of nanotechnology continue to push into new frontiers," commented Striemer.

About SiMPore Inc.
SiMPore Inc. is a Rochester, New York-based nanotechnology company which designs and produces membranes and membrane-enabled products based on its unique patent-pending platform technology—the UltraSM® ultra-thin silicon membrane. The UltraSM® membrane is the world's first membrane to offer both tunable nanometer-scale thickness and pore size. SiMPore is developing products that take advantage of these one-of-a-kind features, including filters for separating and concentrating biological molecules and nanoparticles, cell culture substrates for growing cells, and electron microscopy grids for preparing and imaging samples at the nanoscale. Please visit www.simpore.com for more information.

About TEMwindows.com
TEMwindows.com is a division of SiMPore Inc. and is the exclusive distributor of SiMPore's UltraSM® membrane technology for electron microscopy and related materials imaging and analysis applications. TEMwindows.com is the online source of innovative sample preparation solutions for the imaging and analysis of nanoscale materials. TEMwindows.com features state-of-the-art transmission electron microscopy windows that enable researchers to characterize their cutting-edge nanomaterials. By incorporating the latest MEMS and thin film technologies, TEMwindows.com provides researchers with the resources to advance their research and development programs. TEMwindows.com is fully integrated with, and supported by, the technical expertise at SiMPore, a Rochester, NY-based nanotechnology company. Please visit www.TEMwindows.com for more information.