# Argonne in the marketplace: Microchannel plates with ALD

November 21 2013, by Vic Comello

Think of an eight-inch square honeycomb structure made of glass whose pores are just a few tens of microns thick—the size of a single bacterium. In your mind's eye, you hold the beginnings of a breakthrough technology.

Such honeycombs, developed by Incom, Inc., form the backbone of microchannel plates, which are critical for numerous imaging and sensing applications. These include cheaper medical imaging cameras, high-energy particle detectors, vision enhancement devices, and national security detector arrays capable of scanning inside trucks and shipping containers for hidden nuclear materials.

A microchannel plate amplifies incoming signals so that images are both preserved and enhanced. Researchers apply about 1,000 volts across a microchannel plate from front to back, which makes incoming electrons traverse the open pores. As they do, they crash into the walls of the pores over and over, causing large numbers of new electrons to enter the stream with each impact. Through this avalanche effect, the spatial pattern of electrons at the front surface is amplified up to ten thousand times.

Each tiny pore must have a uniform coating along its length to give its walls the correct electrical conductivity and emission properties. To make this possible, Incom, Inc. turned to Argonne's expertise in a special technique called atomic layer deposition.

Atomic layer deposition, or ALD, is a technique to grow very thin films on complex objects such as Incom's microscopic pores. Researchers feed in reactive chemical vapors to coat the pore walls with a layer of material. The chemical reactions are self-limiting, so each reaction sequence deposits a layer of material just one atom thick, allowing researchers to precisely control the film's composition and make each layer uniform.

To give microchannel plate pores the right electrical properties, Argonne developed ALD processes for blending insulating and conducting materials in exact proportions. The marriage of Incom Inc.'s honeycomb plates and Argonne's ALD films received an R&D 100 Award as one of the most innovative products to be commercialized in 2012.

It turns out that nearly the same conductive coatings promise to help another company, KLA-Tencor, remove a barrier to commercializing its reflective electron beam lithography nanowriter system. The system uses a digital pattern generator chip to independently control a million electron beams at the same time; the idea is to speed up electron beam lithography to make it suitable for high-volume semiconductor manufacturing.

Upon testing the system, however, KLA-Tencor found that the chip quickly becomes electrostatically charged, distorting the patterns being written by the electron beams. Working with KLA-Tencor, Argonne has developed an ALD coating for the chip that permits electrical charges to drain away without distorting the chip's complex nanoscale surface structures or creating an electrical short.

ALD can deposit a wide variety of materials, including oxides, nitrides, sulfides, and metals. Argonne's ALD research program is extending the list of ALD process chemistries to deposit new thin film materials for a broad range of applications.

This research has been supported by the U.S. Department of Energy's Office of High Energy Physics. Work on ALD at Argonne has additionally been funded by the Office of Basic Energy Sciences and Office of Energy Efficiency and Renewable Energy.