Atotech and CWRU to shrink wiring for smaller semiconductors

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The world's lead manufacturer of chemicals for the metal finishing and electroplating industry has just signed a major research contract with Case Western Reserve University, aimed at developing novel chemistries and processes that will enable the manufacturing of smaller semiconductor devices than heretofore possible in routine production.

Such smaller semiconductors are critical to the fabrication of more powerful and more capable computers, phones and other electronic devices.

Atotech Deutschland GmbH, headquartered in Berlin, a global company with 4000 employees, has been collaborating with researchers at Case Western Reserve University for the past six years on developing improved chemistries and characterization techniques for advanced metallization of semiconductor devices by electroplating.

These processes provide via electroplating the nano-scale copper-wire network that distributes the current within the semiconductor device. However, as future generation devices become increasingly smaller, the electroplating technique will be reaching its limit at around 22 nanometer devices, which will soon be in commercial production.

To provide further miniaturization, Case Western Reserve University and Atotech will jointly explore the application of a metallization technology, called electroless deposition, for metalizing semiconductor features smaller than 22 nanometers.

Electroless deposition uses a chemical reaction instead of an electric current to deposit metal layers on devices such as computer chips. Since no electrical current is required to deposit the metal, stand-alone, isolated features can be metalized. The new research will address challenges such as the generation of a high-nucleation density electroless layer to assure sufficient contact and uniform deposition in extremely thin layers, only a few hundred atoms thick.

"The university has the capability to address and resolve the challenges we face in applying this technology," said Robert Preisser, Atotech's vice president in charge of semiconductor technology. "We are prepared to invest, help develop, and then implement the new technology."

Case Western Reserve and Atotech have had a long-term successful relationship. Uziel Landau, chair of the university's chemical engineering department, has worked jointly with Atotech on technology which enables them to electroplate and characterize electrochemical processes used on small scales.

"In conventional electroplating, metals are plated by passing a current" Landau said. "In semiconductor technology applications this technique works down to about 22 nanometer copper interconnect structures."

Continuing down the path of smaller devices requires a whole new technology, Preisser said.

"Electroless deposition has great potential to be used to fabricate extremely small structures that are less than 10 nanometers in size", said Rohan Akolkar, an Associate Professor of Chemical Engineering. Akolkar recently joined Case Western Reserve University after spending many years at Intel's R&D division in Portland, where he led research teams focused on developing novel interconnect strategies.

"A major challenge, and opportunity, for us is to understand the complex electrochemistry in electroless deposition. This electrochemistry is key to enabling smaller, but also more reliable interconnects allowing us to extend Moore's law further" Akolkar said.

Moore's law is an observation that the number of transistors that fit on a chip doubles about every 18 months.

As they did with electroplating, the new venture will explore fundamental and applied science for fabricating the smaller semiconductors. The researchers will investigate chemicals that utilize selective reactions to precisely lay down metal layers on the nanoscale.

"During our years of collaboration, we have accomplished significant progress in the scientific understanding of the nanoscale metallization processes" Preisser said. That relationship will continue and will be further expanded, he added.

Landau said Case Western Reserve University has more faculty involved in electrochemical technology research as a major thrust than any other university in the country. They include researchers in chemical engineering, materials science and engineering, chemistry, and macromolecular science and engineering, who are often collaborating together to address multidisciplinary projects. The new research program will take advantage of these broad scientific capabilities.

"This is multidisciplinary research; one needs to understand metal structures, chemical reactions, surface interactions, and fluid dynamics," Landau said. "It's at the interface of different disciplines."

The research program will centrally involve four faculty members from chemical engineering, materials science and engineering, and the macromolecular science and engineering departments. In addition to the

graduate students involved in the research, Atotech will dedicate several of its own scientists to the program, who will be on-site at Case actively participating in the research and facilitating the collaboration and communication between the university and the company.

Provided by Case Western Reserve University