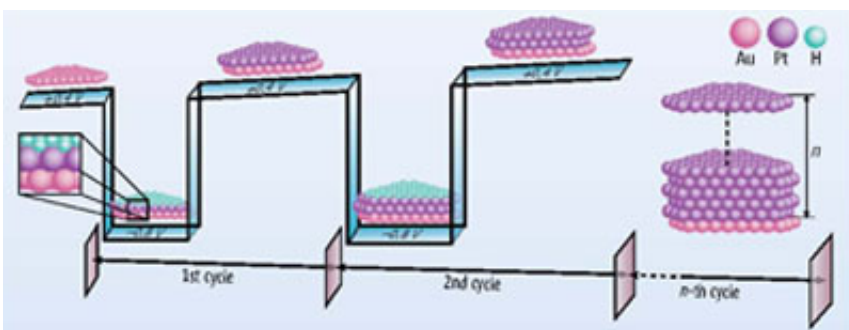


New atomic-layer electrodeposition method yields surprising results

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This illustration depicts how atomic-layer electrodeposition of ultrathin platinum films is achieved through a new process discussed by Missouri S&T Professor of Discovery Jay A. Switzer.

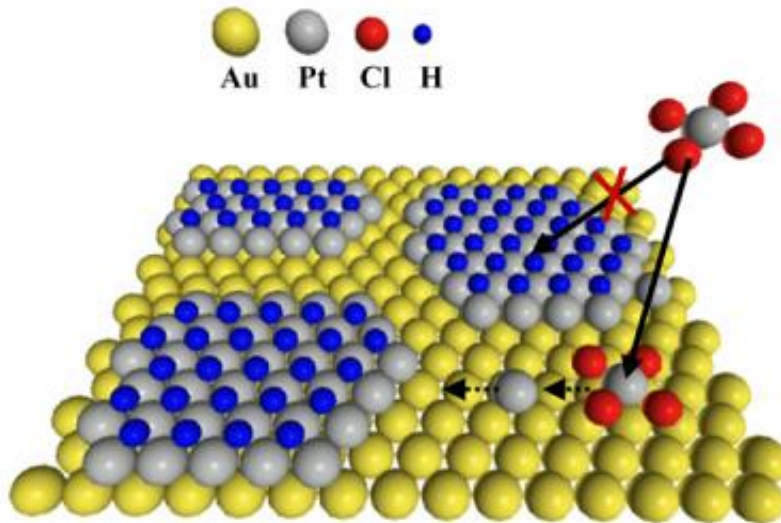
(Phys.org)—A new method for creating very thin layers of materials at the atomic scale, reported in the latest issue of the journal *Science*, could "unlock an important new technology" for creating nanomaterials, according to nanomaterials expert Dr. Jay A. Switzer of Missouri University of Science and Technology in the journal.

Switzer was asked by the editors of *Science* to discuss the research, which identifies a new method of [atomic-layer deposition](#) (ALD), in the "Perspectives" section of *Science*. The research and Switzer's Perspective article both appear in the journal's Dec. 7, 2012, issue.

The research by Dr. Yun Liu and colleagues at the National Institute for

Standards and Technology's Center for Neutron Research describes a new method for depositing ultra-thin layers of [platinum](#) on a surface. The method involves applying a "high overpotential" of electricity to deposit a layer of the metal on a surface, then to toggle to an underpotential to produce a layer of hydrogen. The hydrogen remains in place only briefly, then disappears as scientists adjust the voltage to add new layers of platinum.

The approach yields unexpected results, Switzer says.



Schematic shows self-quenched platinum deposition on a gold surface. Under a high driving voltage, platinum in solution (bound to four chloride atoms) can shed the chloride and bind to a location on the gold. Hydrogen rapidly adsorbs on the platinum, ensuring that the platinum forms an even surface a single atom thick. Credit: Gokcen/NIST

"Conventional wisdom would suggest that the best way to electrodeposit ultra-thin metal films would be to apply either an underpotential or a very small overpotential," writes Switzer, an expert on atomic-layer depositions. Liu and his colleagues "report the surprising result" that a single layer of platinum, placed on the surface at a voltage that should create a thick deposit of the metal, actually creates the layer of hydrogen that limits the thickness of the platinum layer, "thereby making the process self-limiting."

"The beauty of this new electrochemical route to ALD is that it blends basic [electrochemistry](#) and [surface science](#) to unlock an important new technology," says Switzer, who is the Donald L. Castleman/Foundation for Chemical Research Professor of Discovery at Missouri S&T.

Atomic-[layer](#) electrodeposition is a method of "growing" materials in a solution at the nanometer-scale. A nanometer - visible only with the aid of a high-power electron microscope - is one billionth of a meter, and some nanomaterials are only a few atoms in size.

Liu's discovery could result in a new method for growing metal oxides or semiconductors at the atomic scale, Switzer says. "The prospects of this as a general processing method (for [atomic-scale](#) deposition) are encouraging," he writes.

More information: "Self-Terminating Growth of Platinum Films by Electrochemical Deposition," by Y. Liu, *Science*, v. 338, 1327, Dec. 7, 2012. Doi: 10.1126/science.1228925

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