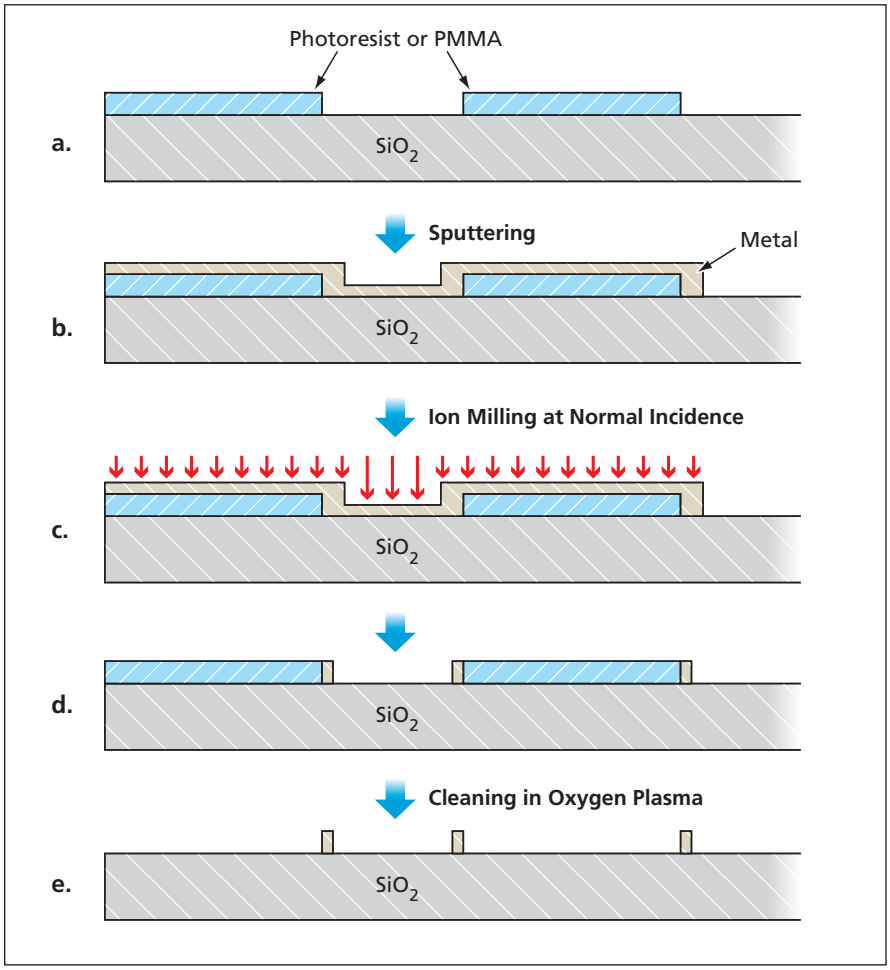
Ion Milling On Steps for Fabrication of Nanowires

This process could readily be scaled up for mass production.

NASA's Jet Propulsion Laboratory, Pasadena, California

Arrays of nanowires having controlled dimensions can now be fabricated on substrates, optionally as integral parts of multilayer structures, by means of a cost-effective, high-yield process based on ion milling on steps. Nanowires made, variously, of semiconductors or metals are needed as components of sensors and high-density electronic circuits.

Unlike prior processes used to fabricate nanowires, the present process does not involve electron-beam lithography, manipulation of nanoscopic objects by use of an atomic-force microscope, or any other technique that is inherently unsuitable for scaling up to mass production. In comparison with the prior processes, this process is rapid and simple. Wires having widths as small as a few tens of nanometers and lengths as long as millimeters have been fabricated by use of this process.



Wall-Like Nanowires are formed at the edges of the photoresist or PMMA when the thickness of the metal is reduced by ion milling at normal incidence.

The figure depicts a workpiece at different stages of the process. A silicon dioxide substrate is coated with a photoresist or poly(methyl methacrylate) [PMMA] to a thickness of as much as 500 nm. The photoresist or PMMA is patterned to form edges where wires are to be formed. A metal — either Pt or Ti — is deposited, by sputtering, to a thickness of as much as 200 nm. By ion milling at normal incidence, the thickness of the metal deposit is reduced until the only metal that remains is in the form of wall-like nanowires along the edges of the photoresist or PMMA. Finally, an oxygen plasma is used to remove the photoresist or PMMA, leaving only the nanowires on the substrate.

This work was done by Minhee Yun, Richard Vasquez, and Choonsup Lee of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1).*

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