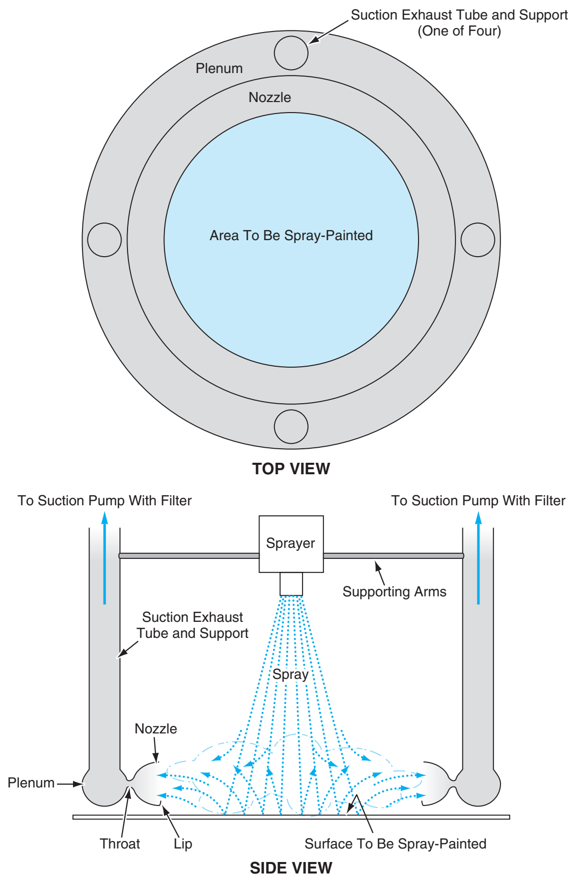
Paint-Overspray Catcher

Turning airflow and entrained droplets would be drawn away.

Langley Research Center, Hampton, Virginia

An apparatus to catch paint overspray has been proposed. Overspray is an unavoidable parasitic component of spray that occurs because the flow of air or other gas in the spray must turn at the sprayed surface. Very small droplets are carried away in this turning flow, and some land on adjacent surfaces not meant to be painted.



The **Paint-Overspray Catcher** would suck the turning flow of gas and entrained paint droplets, preventing the droplets from landing on non-target surfaces. The planform of the catcher plenum and nozzle need not be round as shown here: It could have any other convenient shape, depending on the boundary of the area to be painted.

The basic principle of the paint-spray catcher is to divert the overspray into a suction system at the boundary of the area to be painted. The paint-spray catcher (see figure) would include a toroidal plenum connected through narrow throat to a nozzle that would face toward the center of the torus, which would be positioned over the center of the area to be spray-painted. The plenum would be supported by four tubes that would also serve as suction exhaust ducts. The downstream ends of the tubes (not shown in the figure) would be connected to a filter on a suction pump. The pump would be rated to provide a suction mass flow somewhat greater than that of the directed spray gas stream, so that the nozzle would take in a small excess of surrounding gas and catch nearly all of the overspray. A small raised lip at the bottom edge of the nozzle would catch paint that landed inside the nozzle. Even if the paint is directly piston pumped, the droplets entrain an air flow by time they approach the wall, so there is always a gas stream to carry the excess droplets to the side. For long-duration spraying operations, it could be desirable to include a suction-drain apparatus to prevent overflowing and dripping of paint from inside the lip. A version without an external contraction and with the throat angled downward would be a more compact version of catcher, although it might be slightly less efficient.

This work was done by Leonard M. Weinstein of **Langley Research Center**. *For more information, contact the Langley Commercial Technology Office at (757) 864-6005. LAR-15613*

Preparation of Regular Specimens for Atom Probes

Single- or multiple-tip specimens can readily be prepared.

NASA's Jet Propulsion Laboratory, Pasadena, California

A method of preparation of specimens of non-electropolishable materials for analysis by atom probes is being developed as a superior alternative to a prior method. In comparison with the prior method, the present method involves less processing time. Also, whereas the prior method yields irregularly shaped and sized specimens, the present developmental method offers the potential to prepare specimens of regular shape and size.

The prior method is called the method of sharp shards because it involves crushing the material of interest and selecting microscopic sharp shards of the material for use as specimens. Each selected shard is oriented with its sharp tip facing away from the tip of a stainless-steel pin and is glued to the tip of the pin by use of silver epoxy. Then the shard is milled by use of a focused ion beam (FIB) to make the shard very thin (relative to its length) and to make its tip sharp enough for atom-probe analysis. The method of sharp shards is extremely time-consuming because the selection of shards must be performed with the help of a microscope, the shards must be positioned on the pins by use of micromanipulators, and the irregularity of size and shape necessitates many hours of FIB milling to sharpen each shard.

In the present method, a flat slab of the material of interest (e.g., a polished sample of rock or a coated semiconductor wafer) is mounted in the sample holder of a dicing saw of the type conventionally used to cut individual integrated circuits out of the wafers on which they are fabricated in batches. A saw blade appropriate to the material of interest is selected. The depth of cut and the distance between successive parallel cuts is made such that what is left after the cuts is a series of thin, parallel ridges on a solid base. Then the workpiece is rotated 90° and the pattern of cuts is repeated, leaving behind a square array of square posts on the solid base.

The posts can be made regular, long, and thin, as required for samples for atom-probe analysis. Because of their small volume and regularity, the amount of FIB-milling time can be much less than that of the method of sharp shards. Individual posts can be broken off for mounting in a manner similar to that of the method of sharp shards. Alternatively, the posts can be left intact on the base and the base can be cut to a small square (e.g., 3 by 3 mm) suitable for mounting in an atom probe of a type capable of accepting multiple-tip specimens. The advantage of multiple-tip specimens is the possibility of analyzing many tips without the time-consuming interchange of specimens.

This work was done by Kim Kuhlman and James Wishard of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1).*

In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to

Intellectual Assets Office
JPL
Mail Stop 202-233
4800 Oak Grove Drive
Pasadena, CA 91109-8099
(818) 354-2240
E-mail: ipgroup@jpl.nasa.gov

Refer to NPO-30667, volume and number of this NASA Tech Briefs *issue, and the page number.*

Inverse Tomo-Lithography for Making Microscopic 3D Parts

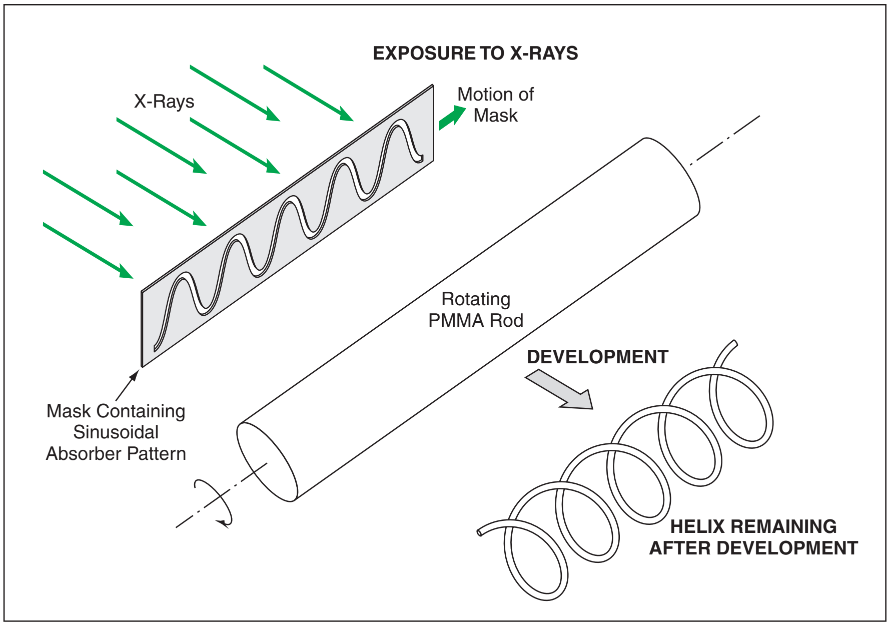
Inverse tomography would be used to generate complex three-dimensional patterns.

NASA's Jet Propulsion Laboratory, Pasadena, California

According to a proposal, basic x-ray lithography would be extended to incorporate a technique, called "inverse tomography," that would enable the fabrication of microscopic three-dimensional (3D) objects. The proposed inverse tomo-lithographic process would make it possible to produce complex shaped, submillimeter-sized parts that would be difficult or impossible to make in any other way. Examples of such shapes or parts include tapered helices, paraboloids with axes of different lengths, and even Archimedean screws that could serve as rotors in microturbines.

The proposed inverse tomo-lithographic process would be based partly on a prior microfabrication process known by the German acronym "LIGA" ("lithographie, galvanoformung, abformung," which means "lithography, electroforming, molding"). In LIGA, one generates a precise, high-aspect ratio pattern by exposing a thick, x-ray-sensitive resist material to an x-ray beam through a mask that contains the pattern. One can electrodeposit metal into the developed resist pattern to form a precise metal part, then dissolve the resist to free the metal. Aspect ratios of 100:1 and patterns into resist thicknesses of several millimeters are possible.

Typically, high-molecular-weight poly (methyl methacrylate) (PMMA) is used as the resist material. PMMA is an excellent resist material in most respects, its major shortcoming being insensitivity. Conventional x-ray sources are not practical for LIGA work, and it is necessary to use a synchrotron as the source. Because syn-



A **Rotating PMMA Rod** would be exposed to collimated x-rays through a mask bearing a sinusoidal absorber pattern while the mask moved along the rod in synchronism with the rotation. Upon development of the PMMA (used here as an x-ray photoresist material), a helix would remain.