



A **Gold Layer Was Patterned** by stamping it with a hexadecanethiol solution. The alkanethiolate SAM pattern thus formed was modified in a  $\text{CF}_4/\text{H}_2$  plasma, forming an etch mask. Then gold was etched away from the areas not masked.

areas of the gold against etching by a potassium iodide (KI) solution. This modification can be utilized, not only in the fabrication of single electronic devices but also in the fabrication of integrated circuits, microelectromechanical systems, and circuit boards.

In the steps that precede the dry plasma process, a silicon mold in the de-

sired pattern is fabricated by standard photolithographic techniques. A stamp is then made by casting polydimethylsiloxane (commonly known as silicone rubber) in the mold. The stamp is coated with an alkanethiol solution, then the stamp is pressed on the gold layer of a device to be fabricated in order to deposit the alkanethiol to form

an alkanethiolate SAM in the desired pattern (see figure). Next, the workpiece is exposed to a radio-frequency plasma generated from a mixture of  $\text{CF}_4$  and  $\text{H}_2$  gases. After this plasma treatment, the SAM is found to be modified, while the exposed areas of gold remain unchanged.

This dry plasma process offers the potential for forming masks superior to those formed in a prior wet etching process. Among the advantages over the wet etching process are greater selectivity, fewer pin holes in the masks, and less nonuniformity of the masks. The fluorocarbon films formed in this way may also be useful as intermediate layers for subsequent fabrication steps and as dielectric layers to be incorporated into finished products.

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## Water-Based Pressure-Sensitive Paints

**Toxicity, and thus costs of ventilation and cleanup, is substantially reduced.**

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Water-based pressure-sensitive paints (PSPs) have been invented as alternatives to conventional organic-solvent-based pressure-sensitive paints, which are used primarily for indicating distributions of air pressure on wind-tunnel models. Typically, PSPs are sprayed onto aerodynamic models after they have been mounted in wind tunnels. When conventional organic-solvent-based PSPs are used, this practice creates a problem of removing toxic fumes from inside the wind tunnels. The use of water-based PSPs eliminates this problem. The water-based PSPs offer high performance as pressure indicators, plus all the advantages of common water-based paints (low toxicity, low concentrations of volatile organic compounds, and easy cleanup by use of water).

A typical PSP (whether conventional or of the present innovative type) contains the following:

- A luminescent compound, the luminescence of which is quenched by oxygen;
- An oxygen-permeable polymeric binder;
- Pigment materials to hide the painted surface and to increase reflectance of

the light emitted from the luminescent compound; and

- Solvents.

The paint is applied to a surface of interest in a model and allowed to dry. During a subsequent wind-tunnel test, under the appropriate illumination, the intensity of luminescence emitted by the

PSP is inversely proportional to the concentration of oxygen, hence, to the air pressure at the painted surface.

A water-based PSP contains all the basic ingredients of a conventional PSP (see table), except that the organic-solvent content (if any) is much smaller and the basic ingredients are incorpo-

Ingredient	Proportion in Weight Percent
water emulsion of poly-trifluoroethylmethacrylate-co-isobutylmethacrylate (1:1)	42 to 68.4
propylene glycol	2.28
a glycol ether	10.26
$\text{TiO}_2$ (pigment)	11.35
N-methyl pyrrolidinone	6.00
Byk 346 (or equivalent solution of polyether-modified dimethylpolysiloxane)	0.68
Lubrizol 2062 (or equivalent) aliphatic/aromatic phosphate ester for solvent-borne and water-borne coatings	1.03
platinum tetra(pentafluorophenyl)porphyrin (a luminophore)	0.1

A **Typical Water-Based PSP Formulation** is shown here.

rated in a water matrix. The oxygen-permeable polymer is prepared as a water-borne emulsion. This is blended with the necessary coalescing agents, coupling solvents, luminophore, and pigments. The resulting water-based PSP can be applied by spraying to obtain a single coat, which cures to touch in less than one hour and cures for use in 12 hours at room temperature. The cured

paint is smooth and has good adhesion to most metal and plastic substrates.

*This work was done by Jeffrey D. Jordan and A. Neal Watkins of **Langley Research Center** and Donald M. Oglesby and JoAnne L. Ingram of Swales Aerospace. Further information is contained in a TSP (see page 1).*

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