Templates for Deposition of Microscopic Pointed Structures

These structures can be used as field emitters in plasma television screens.

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Templates for fabricating sharply pointed microscopic peaks arranged in nearly regular planar arrays can be fabricated by a relatively inexpensive technique that has recently been demonstrated. Depending on the intended application, a semiconducting, insulating, or metallic film could be deposited on such a template by sputtering, thermal evaporation, pulsed laser deposition, or any other suitable conventional deposition technique. Pointed structures fabricated by use of these techniques may prove useful as photocathodes or field emitters in plasma television screens. Selected peaks could be removed from such structures and used individually as scanning tips in atomic force microscopy or mechanical surface profiling.

The equipment and materials needed to form a template include the following:

- Several small plates (e.g., microscope slides) made of a suitable (preferably transparent) rigid material such as glass, quartz, or sapphire;
- Two permanent magnets that produce a flux density of the order of 1 kG (0.1 T) with an acceptably low spatial variation over an area at least as large as that of the template to be formed; and
- A ferrofluid (consisting of Fe_2O_3 particles suspended in an oil-based solution that includes a surfactant).

A small quantity (≈1 mL) of the ferrofluid is either dropped or spun onto one of the plates. The plate is oriented horizontally, supported by two other plates, positioned so that the ferrofluid-covered spot sits directly over one of the magnets. Next, using a combination of three other plates, the other magnet is positioned a short distance above the ferrofluid-covered spot (see Figure 1). The surface of the ferrofluid becomes deformed into an array of peaks generally oriented along magnetic-field lines. The positions of the magnets relative to each other and to the ferrofluid are adjusted to minimize nonuniformity in the array of peaks and to maximize the aspect ratio of the peaks. Next, the ferrofluid is dried in room air using a gently blowing muffin fan. The ferrofluid is then further dried and hardened in a thermal evaporation chamber pumped down to a pressure of about 10^{-6} torr (about 1.3×10^{-4} Pa).

The resulting structure is ready for use as a template for deposition. For example, Figure 2 shows selected views of such a template that has been coated with thermally evaporated silver.

This work was done by Diane E. Pugel of Goddard Space Flight Center. Further information is contained in a TSP (see page 1).

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to the Patent Counsel, Goddard Space Flight Center, (301) 286-7351. Refer to GSC-14871-1.

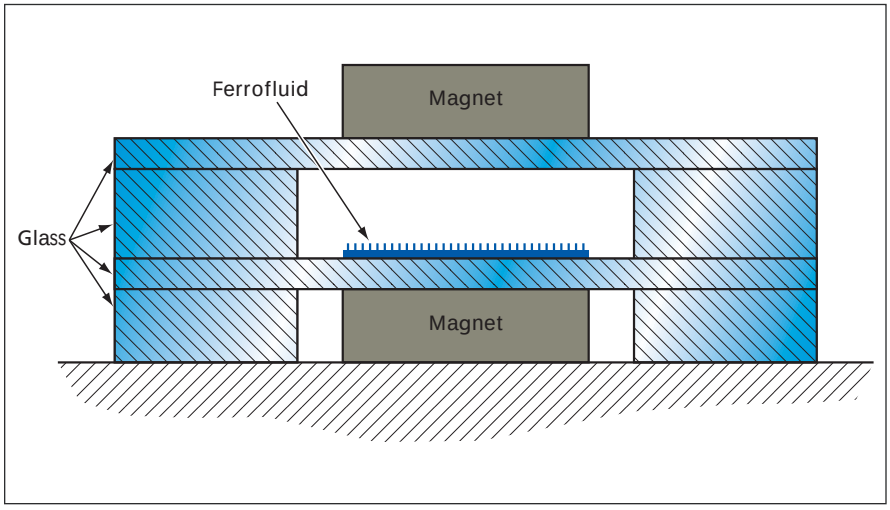

Figure 1. A **Spot of Ferrofluid on a Plate** is positioned between two magnets. The magnetic field deforms the upper surface of the ferrofluid into an array of peaks.

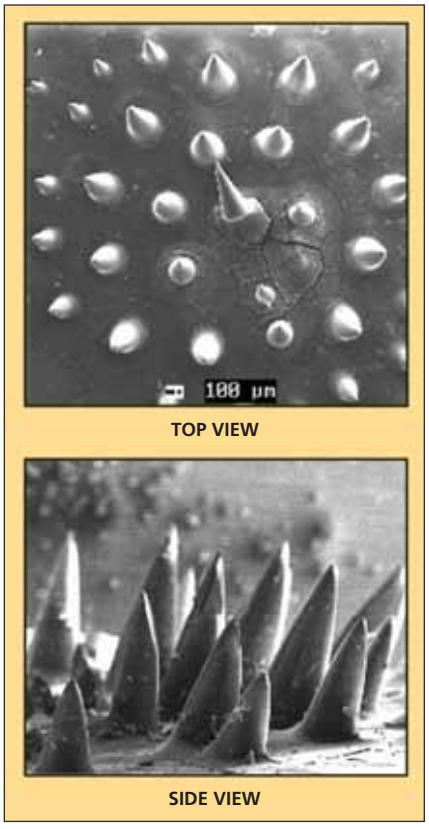

Figure 2. A **Portion of a Template** fabricated as described in the text is shown here in top-view and side-view scanning electron micrographs.