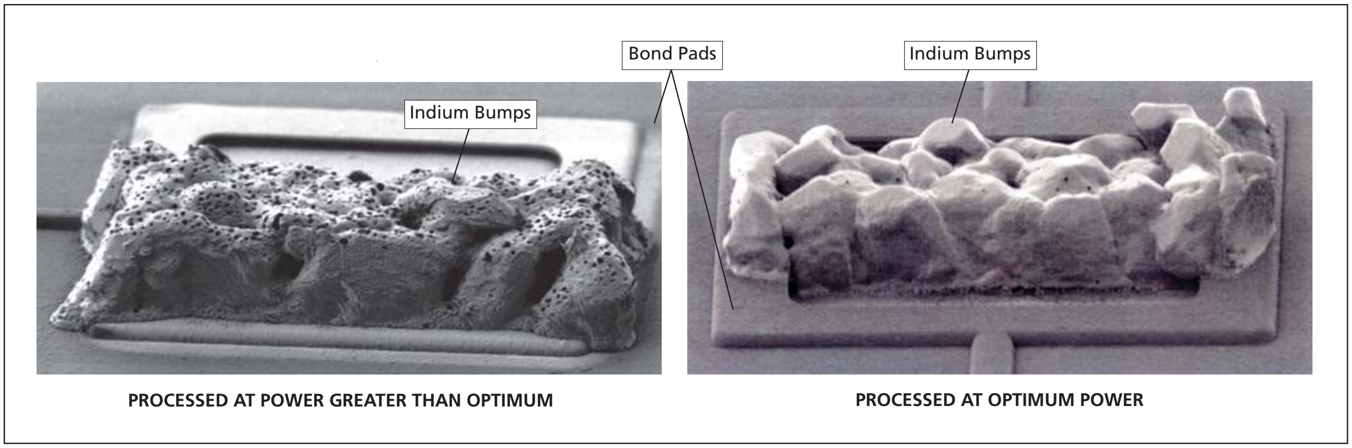

These **Indium Bonding Bumps** were treated by two different versions of the two-step plasma process. The pockmarks on the left bump were caused by using greater-than-optimum plasma-generating power in the second step of the process. The right bump was processed at optimum power.

etching with hydrochloric acid. Unfortunately, once the oxide is removed, the acid can continue to attack the indium, reducing the size of the bumps and even undercutting them. The acid can also attack metal layers on and under the bond pads, potentially creating open circuits and thus negating the benefit of removing the oxide. In contrast, the two-step plasma process makes it possible to remove surface indium oxide, without incurring the adverse effects of the acid etching process.

In the first step of the plasma process, a device on which indium bonding bumps has been formed is exposed for a suitable amount of time (typically, 20 minutes) to a plasma generated in a gaseous mixture of 1/3 argon + 1/3 methane + 1/3 hydrogen. During this step, the oxygen in the indium oxide is removed through incorporation into CO and CO_2 gas molecules, while the indium in the indium oxide is removed through incorporation into $In(CH_3)$, which is volatile. Following this step, a carbonaceous surface film is also formed on device surfaces that are not covered by indium.

A second step for removing the carbonaceous film is as follows. The device is exposed to a plasma generated in a gaseous mixture comprising 72 percent of argon and 28 percent of hydrogen. This step greatly reduces the carbon content without exerting any significant adverse effect on the indium. The power used to generate the plasma in this step must be chosen carefully: the power should be high enough to ensure effective removal of the carbonaceous film, but not so high as to melt or otherwise damage the indium bumps (see figure).

This work was done by Harold F. Greer, Richard P. Vasquez, Todd J. Jones, Michael E. Hoenk, Matthew R. Dickie, and Shouleh Nikzad of Caltech for NASA's Jet Propulsion Laboratory.

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:

Innovative Technology Assets Management
JPL
Mail Stop 202-233
4800 Oak Grove Drive
Pasadena, CA 91109-8099
E-mail: iaoffice@jpl.nasa.gov

Refer to NPO-45911, volume and number of this NASA Tech Briefs *issue, and the page number.*

Tool for Crimping Flexible Circuit Leads

Lyndon B. Johnson Space Center, Houston, Texas

A hand tool has been developed for crimping leads in flexible tails that are parts of some electronic circuits — especially some sensor circuits. The tool is used to cut the tails to desired lengths and attach solder tabs to the leads. For tailoring small numbers of circuits for special applications, this hand tool is a less expensive alternative to a commercially available automated crimping tool. The crimping tool consists of an off-the-shelf hand crimping tool plus a specialized crimping insert designed specifically for the intended application.

The components of the insert and their roles include the following:

- A pin guide aligns pins on the solder tabs with the leads in a tail that is part of the flexible circuit.
- A punch pushes the pins through the pin guide and crimps them onto the tail.
- A forming plate aligns the tail over grooves that form the pins from the solder tabs.
- A spaceplate includes a surface that serves as a stop for positioning the tail when the tail is inserted in the forming plate.
- A dowel pin enables semi-permanent assembly and alignment of the punch, pin guide, and springs.
- A pin holder holds and helps to align the solder tabs before crimping.

This work was done by Aaron Hulse and Myron A. Diftler of Lockheed Martin Corp. for Johnson Space Center. Further information is contained in a TSP (see page 1). MSC-23461-1