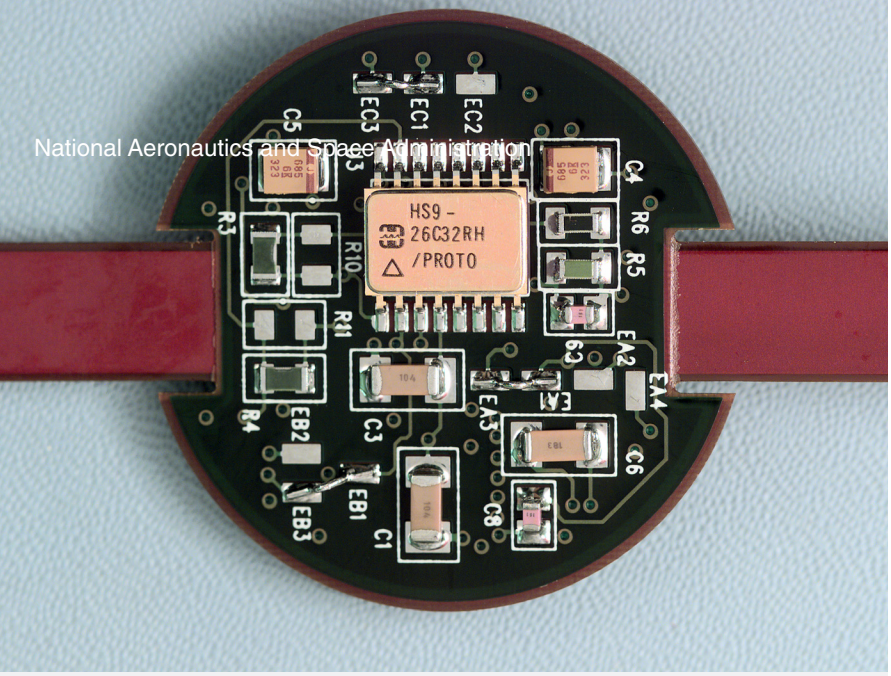


Materials and Coatings

Improved Indium Bump Bonding Using Multi-Step Plasma Process

Better conductivity for flip chip hybridization

Indium bump bonding is one standard method of connecting electronic chips to circuit boards. Indium solder “bumps” are deposited over contact pads of both the chip and the board, and then the contact pads are aligned and pressed together to form an electrically conductive bond. One issue with this technique is the formation of oxides on indium bumps when they are exposed to air. This oxide leads to resistance in the contact, limiting the electronic performance. We describe a unique multi-step plasma process to remove this oxide. Its key advantage is that it preserves the indium itself more effectively. This process could also lead to smaller contact pads and flip-chip circuits, which are of particular interest to any application requiring compact electrical systems.

BENEFITS

- Indium bumps exposed to this process seem to exhibit less damage
- Can be used to bond CMOS imager flip-chips to circuit boards with superior results

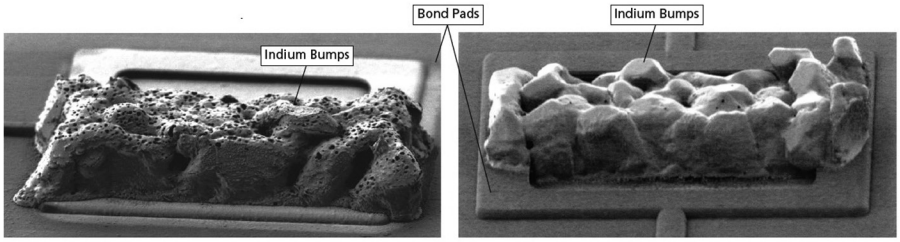
technology solution

THE TECHNOLOGY

The process described here uses a relatively low-power plasma to remove the indium oxide with less sputtering of the underlying indium, and a second step to remove organics left from the first step. A typical recipe for this process would be:

1. Plasma composition: 33% Argon / 33% Methane / 33% Hydrogen at 75mTorr with a power of 70W for 20 minutes
2. Plasma composition: 72% Argon / 28% Hydrogen at 80 mTorr with a power of 40W for 20 minutes

Typical processing time for each step was 20 minutes, although those times could likely be reduced.



PROCESSED AT POWER GREATER THAN OPTIMUM

PROCESSED AT OPTIMUM POWER

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 greated-than-optimum plasma-generating power in the second step of the process. The right bump was processed at optimum power.

APPLICATIONS

The technology has several potential applications:

Consumer electronics – compact electronics for cell phones and mobile devices

Automotive – robust sensors and computers for cars and trucks

PUBLICATIONS

U.S. Patent 8,163,094

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NP-2014-08-1145-HQ

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NPO-45911-1