Worldwide Coverage: Optics, Lasers, Imaging, Fiber Optics, Electro-Optics, Photonic Component Manufacturing
PHOTONICS SPECTRA

Photonics Problem-Solver

Can anyone out there fill these reader needs?

Solutions to Problems in Previous Issues

Sealing Windows

We are searching for a reliable way to seal germanium or silicon windows into metal window caps or onto ceramic chip carriers for use in an IR emitter for the mid- and long-wavelength spectrum. The seal must be hermetic and able to withstand millitorr vacuum conditions. It also must not outgas or damage the window material.

James Melnyk, Sales Manager
Ion Optics
Waltham, Mass.
Code No. 13,201

Window Sealing

In the May issue, James Melnyk requested a reliable way to seal germanium or silicon windows into metal caps or onto ceramic chip carriers. He said the seals must be hermetic and able to withstand millitorr vacuum conditions. Possible ways include:

Epoxy. Torr Seal is a very low outgassing epoxy available from Varian Inc. It is manufactured specifically for use in high-vacuum systems and is used at pressures below 5×10^{-8} t and at temperatures from −45 to 120 °C. It adheres to the materials mentioned above, as well as to glass, sapphire and calcium fluoride, for example.

Solder. If the nonmetallic parts are made solderable — e.g., by sputtering Ti, Ni and Au thin films — they can be soldered with many of the tin/lead and indium alloys, producing a hermetic seal.

U/S Indium. Indium can readily be made to adhere to the specified materials by use of ultrasonics and can be used to make the required hermetic seal. It has an extremely low vapor pressure, even though it has a melting point of 156.6 °C. One would need to use ultrasonics for adhesion to the above semiconductors and insulators, although indium will bond directly to many metals with pressure, or with pressure and heat.

U/S Aluminum. Aluminum can be ultrasonically "welded" to glass, silicon and, possibly, the more fragile germanium. This could provide a robust hermetic seal; however, thermal expansion mismatch might reduce the reliability of such a joint.

Ionic Bonding. This process can produce excellent hermetic joining of appropriate materials. It is used to attach cover glass to solar cells. Normally, one of the materials has to be a glass containing sodium ions, such as borosilicate. However, a silicon-dioxide film on the germanium and silicon parts might enable this technique.

Titanium Hydride. At about 700 °C, titanium hydride decomposes into atomic titanium and atomic hydrogen — two very reactive species. Heating a film of titanium hydride on fused silica produces an adherent titanium film. If a fused silica or silicon window is assembled with a film of titanium hydride, a tin/lead alloy and a suitable metal cap, and is fired in an inert, or hydrogen-rich, atmosphere, a very robust and hermetic seal can be produced. In this case, a close thermal expansion match would be necessary between the bulk materials because of the high processing temperature.

Peter Cone
Baker Research Inc.
Bedford, Mass.