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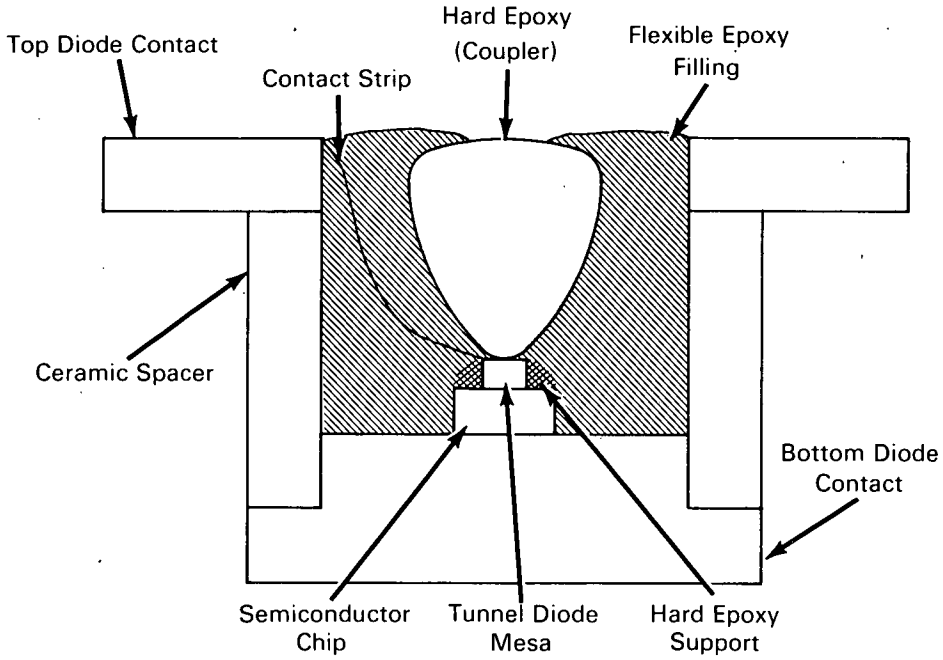
NASA TECH BRIEF

Pressure-Sensitive Bonded Junction Transducers



Pressure sensitivity of semiconductor junctions, such as in transistors and diodes, has been a subject of extensive investigation. Specifically, considerable efforts have been made to develop electromechanical transducers based on these piezojunction effects. To achieve significant electrical response in these devices, the stress magnitude at the junction must be quite large ($\geq 10^8$ dynes/cm^2); yet for many practical purposes the applied forces to which most of the transducers must respond are often only a few grams or less. An obvious solution is to concentrate the applied force over very small areas of the device, an approach that has been generally adopted. Generally, the desired stress concentration has been accomplished by the use of fine, hard styli resting on the surface of the device and, in one case, by a needle-shaped semiconductor diode in contact with a flat surface. In these approaches, operation of the device is thus based on intimate, uniform contact between a minute, hard semiconductor surface and a hard solid. In practice, however, it is extremely difficult to maintain two very hard surfaces in uniform contact over a minute area. Surface irregularities of micron or even submicron size will lead to damage in the semiconductor, and it is difficult to prevent lateral displacement of the contact area during operation, or particularly during assembly of the device.

These problems have been solved by the design of miniature transducers which involve the use of appropriate commercial epoxy resins. These provide (a)

(continued overleaf)

a means of equalizing the pressure in the small contact area between the hard stressing member and the semiconductor, (b) a support for the delicate mesa structures exposed to anisotropic stresses, and (c) a mechanical linkage. The mesa structure, i.e., a minute device surface protruding over the surrounding inactive region, is chosen in order to achieve maximum stress concentration. The pressure equalization and mesa support are provided by a hard epoxy, while a flexible epoxy is used to avoid excessive damping in the mechanical coupling to the device. Such use of epoxies can equally well be applied to tunnel diodes as well as to other semiconductor junction devices. Furthermore, unlike in previous constructions, the present design protects the sensitive semiconductor surface from ambients and excludes an air space in the device capsule, which expands or contracts with temperature variations.

Notes:

1. The miniature size and small power requirements of these piezojunction devices should make them particularly desirable as force or pressure sensors in biomedical applications.
2. Details may be obtained from:
   Clearinghouse for Federal Scientific
   and Technical Information
   Springfield, Virginia 22151
   Price: $3.00
   Reference: TSP68-10563

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

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