September 1970

Brief 70-10460

NASA TECH BRIEF

Fabrication of Electroacoustic RF Amplifiers

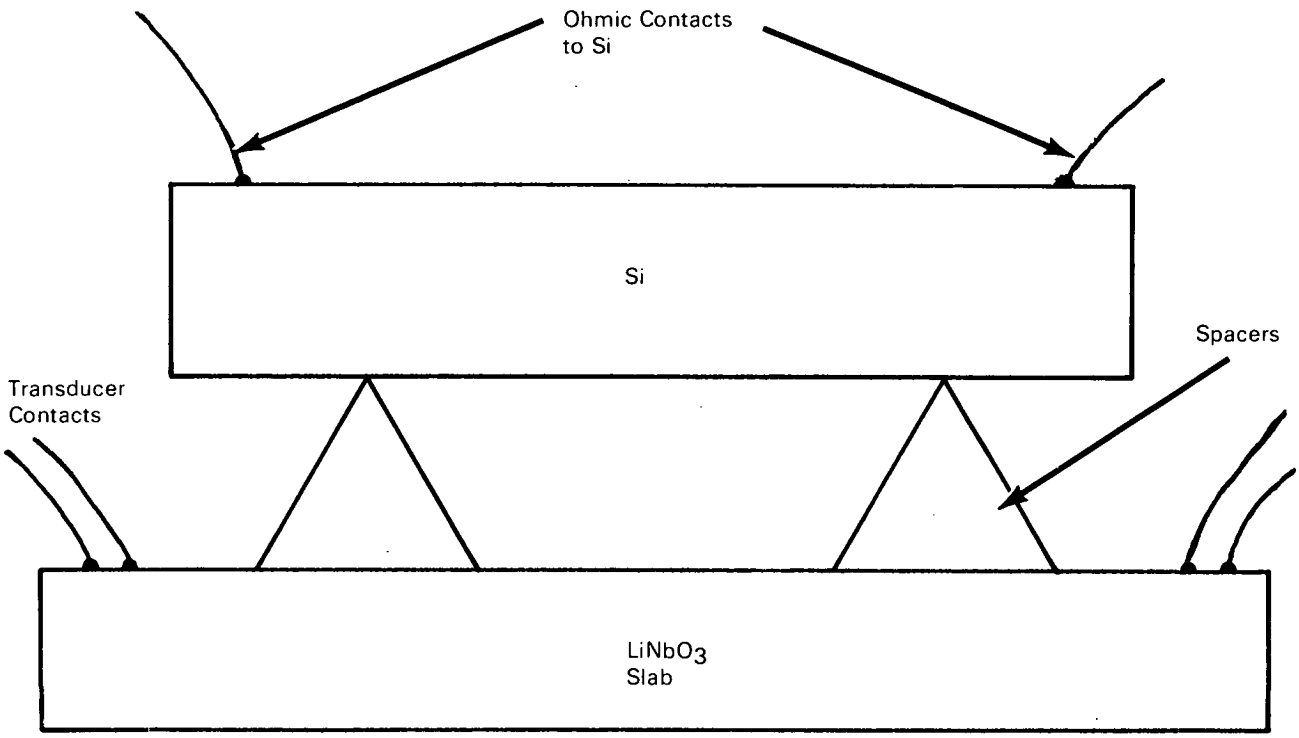

Figure 1. Diagram of Basic Concept

The problem:

To develop a method to point-contact mount two small rectangular slabs, one piezoelectric and the other a silicon semiconductor, within 600 Å of each other (Fig. 1). This structure results in a solid-state device broadly equivalent to a traveling-wave tube.

The solution:

Anodic bonding (P.R. Mallory process) of a lithium niobate piezoelectric crystal over a silicon-on-sapphire structure, with the crystal mounted over a closely controlled oxide. Surface acoustic effects between the crystal and silicon provide input-to-output gain and impedance-matching.

How it's done:

Figure 2 shows the structure of the electroacoustic amplifier. Drift fields are set up in the silicon by use of segmented metallic contacts. Current-carriers induced by the drift field move parallel to the direction of the surface acoustic waves, with velocities exceeding those of the surface waves. The drift fields, with

(continued overleaf)

positive drift carrier action, in synchrony with the acoustic wave forms in the $LiNbO_3$, must be in excess 1 kV/cm to obtain terminal gain. With use of anodic bonding, structural dimensions can be such that, with suitably arranged metal contacts, the desired drift field can be attained with fairly low applied potentials.

In summary: The improvement in fabrication is the ability to mount the slab of $LiNbO_3$ in the correct orientation and at the proper distance from the silicon surface by use of the anodic-bonding technique.

This innovation may be useful for (1) two-port phasing networks with forward gain and impedance-matching properties applicable to phased-array antenna systems; (2) rf and i.f. amplifiers, with elimination of currently used air and ferrite-core inductors for tuning purposes; and (3) remote biomedical monitoring of personnel. The technique may interest designers or manufacturers of communications equipment, biomedical systems, or semiconductor devices.

Note:

Requests for further information may be directed to:

Technology Utilization Officer
Headquarters
National Aeronautics
and Space Administration
Washington, D.C. 20546
Reference: B70-10460

Patent status:

This is the invention of a NASA employee and a patent application has been filed. Inquiries concerning license rights may be made to the inventor, R. L. Trent, through NASA Headquarters.

Source: R. L. Trent
Electronics Research Center
(ERC-10266)

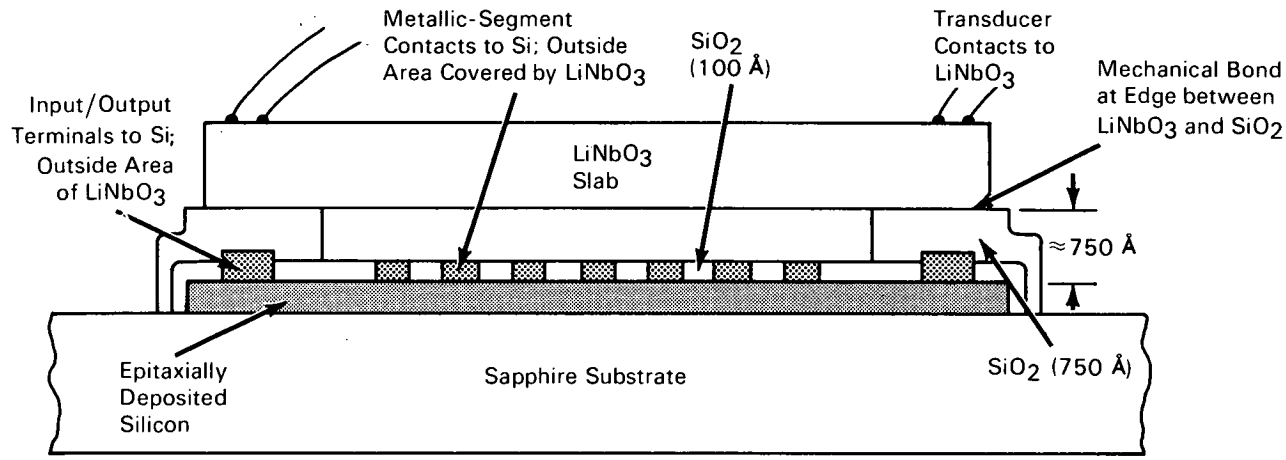

Figure 2. Structure of Electroacoustic Amplifier; Diagrammatic.