ACOUSTICS2008/1545
Wafer bonded, local oxidation defined, capacitor micromachined ultrasonic transducers for medical applications

Butrus (pierre) Khuri-Yakub, Kwan Kyu Park, Hyunjoo Jenny Lee, Mario Kupnik and Omer Oralkan
E. L. Ginzton Laboratory, Stanford University, Stanford, CA 94305, USA

We present a technology for making capacitive micromachined ultrasonic transducers (CMUTs) that is based on direct wafer bonding of silicon on insulator wafer (SOI), and where the vertical dimensions and geometry of the CMUT are defined by local oxidation (LOCOS). The advantages of this approach for making CMUTs is the excellent control, no only over the membrane properties, but also over the shape and dimensions of the cavity. We demonstrated the ability to make devices with cavities in the 10s of nanometer range which enables devices up to a frequency of 100 MHz. The devices exhibit reduced charging where we measure a voltage shift of 0.03 V for devices cycled in and out of collapse at 50 V. The devices also have reduced parasitic capacitance as thicker oxides are grown in the regions of the SOI bond to the membrane. These are typically the regions that contribute most to the parasitic capacitance. Finally, because of the reduced charging, it is possible to operate these devices in and out of collapse which results in higher output pressure than devices operating in conventional mode. Hence, these CMUTs are much more predictable and reproducible in their operation and performance.