

## Wafer Fusion Bonding: Characterization of the Bond Quality

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The basic principles of wafer fusion bonding are presented and the quality of wafer-to-wafer bonds investigated with regard to sensor applications. Experiments with different wafer surfaces including plasma-deposited films are presented. Direct observation of the room-temperature bonding with infrared transmission allows the detection of nonbonding areas and therefore the optimization of the bonding process. Results obtained for preprocessed silicon wafers with etched grooves or structured surfaces are compared with full-wafer bonding. Samples treated under various annealing conditions have been investigated. Homogeneity and bond strength after thermal and vibrational stress treatments, sealing of bonded interfaces, and the analysis of the remaining gas in closed cavities are presented. The results are discussed with regard to micromechanical applications.

### 1. Introduction

In the last few years interest in the silicon direct bonding technique<sup>(1-3)</sup> has increased in different fields of applications. The rather simple bonding process, which contains mating of a wafer pair at room temperature and subsequent annealing, seems to be advantageous not only because of its flexibility, but also because no additional materials are present at the interface.