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Field-Assisted Bonding of a Machinable Ceramic to Silicon and Metals

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Field-assisted low-temperature bonding of silicon and metals to a machinable ceramic is presented. The bonding parameters, mechanism and strength are investigated and an STEM/EDS analysis of the silicon-ceramic seal is peformed. Application of the technique for joining microfluid components is demonstrated.

1. Introduction

Field-assisted low-temperature bonding of silicon and certain metals and alloys to glass and β-alumina to metals have previously been reported.[1,2] Bonding of silicon to silicon, with or without an intermediate SiO_2 in between, is a relatively new discovery that involves high-temperature processing[3–5] ($>800°C$). Both sealing techniques have attracted interest in the sensor and the semiconductor industry.[6–9] In the sensor field, these techniques have allowed the fabrication of multilayer structures and cavities of Si-glass and Si–Si systems, whereas the interest in the semiconductor community has been focused on new means of producing SOI structures.

In this paper, we report the bonding of a commercial ceramic material to silicon and some metals using low-temperature field-assisted bonding. To our knowledge, bonding of a ceramic to silicon has previously not been reported. Results indicate that strong and hermetic seals can be made to silicon. An advantage of the technique is the machinability of the ceramic and the fact that the ceramic is thermally relatively closely matched to silicon, which is demonstrated in an application where two microfluid components are joined with a strong seal.

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