

Silicon-To-Silicon Anodic Bonding via Intermediate Borosilicate Layer for Passive Flow Control Valves

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Abstract : Flow control valves comprise a silicon flexible membrane that deflects against a substrate, usually made of glass, containing pillars, an outlet hole, and anti-stiction features. However, there is a strong interest in using silicon instead of glass as substrate material, as it would simplify the process flow by allowing the use of well controlled anisotropic etching. Moreover, specific devices demanding a bending of the substrate would also benefit from the inherent outstanding mechanical strength of monocrystalline silicon. Unfortunately, direct Si-Si bonding is not easily achieved with highly structured wafers since residual stress may prevent the good adhesion between wafers. Using a thermoplastic polymer, such as parylene, as intermediate layer is not well adapted to this design as the wafer-to-wafer alignment is critical. An alternative anodic bonding method using an intermediate borosilicate layer has been successfully tested. This layer has been deposited onto the silicon substrate. The bonding recipe has been adapted to account for the presence of the SOI buried oxide and intermediate glass layer in order not to exceed the breakdown voltage. Flow control valves dedicated to infusion of viscous fluids at very high pressure have been made and characterized. The results are compared to previous data obtained using the standard anodic bonding method.

Keywords : anodic bonding, evaporated glass, flow control valve, drug delivery

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