Dendritic nanostructures and pattern formation in anodic bonding of Pyrex glass and crystalline silicon coated with aluminum ultra-thin film

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Anodic bonding, with metal or alloy thin films as an intermediate layer, finds increasing applications in micro/nano electromechanical systems (MEMS/NEMS). At the bonding temperature of 350°C, voltage of 400 V and duration of 30 minutes, the anodic bonding is completed between Pyrex glass and crystalline silicon coated with aluminum ultra-thin film of the thickness of 500, 950, 1500, and 2300 Å, respectively. The sodium depletion width does not increase remarkably with the thickness of aluminum interface used in this experimental study. The aluminum diffusion into the Pyrex glass is observed in the dendritic morphology. The induced local non-uniform electric fields govern the diffusion of aluminum and the dendritic growth of nanostructures in the depletion layer. Many crystallized areas are formed in the dendritic nanostructures, which is an important mechanism for the high bonding strength.

We also observed the pattern formation of diffusion-limited aggregation (DLA) in the anodic bonding with aforementioned bonding conditions.

Keywords: anodic bonding, dendritic nanostructures, depletion layer, DLA

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