

Microfabrication of a Pressure Sensor Array Using 3D Integration Technology

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Abstract

A novel microfabrication approach that enables successful integration of a piezoresistive pressure sensor array on an airfoil for detection of micro-scale turbulent vortices is presented. These sensor arrays will be used to study the dynamics of turbulent air flow with the ultimate goal of reducing drag on aircraft. Minimization of surface undulations on the sensor is required to avoid generating additional air turbulence. Therefore it is essential to implement an enabling fabrication approach that eliminates the dependence on topside electrical connections. We have developed a 3D integrative process to provide backside interconnections, while maintaining the specified 200 μm sensor element pitch. This 3D fabrication effort incorporates several advanced process technologies including: low temperature SiO₂-to-Si wafer bonding (<250°C), bulk wafer thinning (to 20 μm), HAR (20:1) Si and SiO₂ etching using m=0 resonant induction (MORI), and HAR (10-15:1) metallization using high pressure Aluminum reflow. This integrative process will facilitate vertical stacking of multiple device components on different layers, allowing the integration of MEMS and microelectronic devices for the realization of Small Smart Systems (SSS). Process developments and preliminary experimental results are presented.