MEMS Packaging for Reliable, Low Pressure Sensing in Automotive Applications

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Abstract

In the past 10 years, MEMS-based sensors have become the most common technology for low pressure (less than 100kPa) sensing in automotive applications, growing to a multibillion dollar market. Harsh environments such as that found in automotive applications present great challenges for MEMS devices. These challenges can be broadly categorized into three primary regimes: chemical, mechanical and thermal. The chemical constituents present challenges in that exhaust and other automotive media is corrosive to many MEMS materials. The vibrational and thermal profiles of underhood and underbody applications also present challenges to reliable MEMS packaging. This paper focuses on the design tradeoffs present in packaging piezoresistive MEMS sense elements with respect to signal integrity, vibrational interactions, and mitigating factors for chemical protection. Of particular focus is the susceptibilities and failure modes present with front-side metallization exposed to exhaust media. The concept is shown to function in temperatures ranging from -40C to 140C, vibrational loads up to 20Grms, and in chemical environments with pH as low as 1.6pH.