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Lessons Learned from Failure Analyses of Electronic Components

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Passive electronic components are multi-material assemblages, with many different ceramics and glasses. For high-consequence applications of commercial components, accelerated aging and over-tests are also employed; when failures occur, analysis of their origins/modes can provide important insights into improving materials, processes or designs.

We describe the methods employed, lessons learned and corrective actions from five such failures. Optical and SEM fractography, strength testing, and fracture mechanics principles were employed to understand the causes. The first two examples are classical brittle failures: failure of a single crystal quartz-beam timing resonator in mechanical shock was attributed to a defect missed during inspection, and failure of polycrystalline alumina in a thick-film resistor during vibration loading was attributed to excessive bending, due to variability in the thickness of the epoxy-underfill. The third case is a "glue-spalling" failure of a thick film resistor during thermal cycling. The fourth study is that of a Kovar-glass seal interface delamination, due to mishandling, that compromised the hermeticity of a transistor. The final study describes the failure of a glass-body diode which is attributed partly to strain imposed due to the protective polymer coating during thermal cycling.

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