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Optimization of Alkali Silicate Glass Heat Treatment for the Improvement of Thermal Expansion and Flexural Strength

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Abstract : The objective of this study is to describe the framework for optimizing the heat treatment of alkali silicate glasses, to enhance the performance of hermetic seals in extreme environments. When connectors are exposed to elevated temperatures, residual stresses develop due to the mismatch of thermal expansions between the glass, metal pin, and metal shell. Excessive thermal expansion mismatch compromises the reliability of hermetic seals. In this study, a series of heat treatment schedules will be performed on two commercial sealing glasses (one conventional sealing glass and one crystallizable sealing glass) using a design of experiments (DOE) approach. The coefficient of thermal expansion (CTE) will be measured pre- and post-heat treatment using thermomechanical analysis (TMA). Afterwards, the flexural strength of the specimen will be measured using a four-point bend fixture mounted in a static universal testing machine. The measured material properties will be statistically analyzed using MiniTab software to determine which factors of the heat treatment process have a strong correlation to the coefficient of thermal expansion and/or flexural strength. Finally, a heat-treatment will be designed and tested to ensure the optimal performance of the hermetic seals in connectors.

Keywords : glass-ceramics, design of experiment, hermetic connectors, material characterization
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