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Solvent Presence and its Impact on the Lap-Shear Strength of SDS-Decorated Graphene Hybrid Electrically Conductive Adhesives

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Abstract

The mechanical bonding strength of electrically conductive adhesives (ECAs), as well as the impact of residual solvent on the bonding strength was investigated between a copper clad FR-4 surface and conductive adhesives using Lap-shear testing. Both solvent-free and solvent-assisted formulations with various filler concentrations of silver (Ag) and sodium dodecyl sulfate (SDS)-decorated graphene (Gr(s)) in epoxy matrices were prepared and compared. It was found that the introduction of 0.75 wt% Gr(s) in solvent-free formulations increased the Lap-shear strength (LSS), while the combination of ethanol solvent and SDS in solvent-assisted formulations significantly decreased the LSS. In addition, it was found that increasing the Ag content generally lowers the LSS for both the solvent-free and solvent-assisted formulations. By examining the structure and interface of both formulations using optical microscopy, surface profilometry and SEM, we found that the solvent-assisted formulations exhibit more voids at the surface of the paste and more bubble formation throughout the material compared to the solvent-free formulations. Therefore, the significant drops of LSS in solvent-assisted Gr(s)-filled formulations may be attributed to the formation of bubbles at the micron range during the curing process.