# CONDUCTIVITY OF CARBON BLACK (CB) AND GRAPHITE (G) ADDITION IN SILICONE-BASED ELECTRICALLY CONDUCTIVE ADHESIVES (ECAs)

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## ABSTRACT


**CONDUCTIVITY OF CARBON BLACK (CB) AND GRAPHITE (GR) ADDITION IN SILICONE-BASED ELECTRICALLY CONDUCTIVE ADHESIVES (ECAs)**

Electrically conductive adhesives (ECAs) have raised a massive interest among researchers to replace traditional Tin-Lead (Sn-Pb) solders especially in electronic manufacturing devices due to its greater attributes than utilizing lead (Pb) which is harmful to human health. In this study, silicone-based ECAs was proposed with the addition of hybrid fillers namely, carbon black (CB) and graphite (G) in which CB and G are both conductive fillers while silicone, specifically polydimethylsiloxane (PDMS) is used as the polymer matrix. By incorporating wet-ball milling method to achieve optimum dispersion of the fillers in the matrix and adopting film casting technique to form thin films beforehand, then the optimum ratio of CB and G (1:2, 2:1, 2:2, 1:3 and 3:1 ratio) on its conductivity properties of CB/G/PDMS composite via multimeter and 4-point probe was identified and the CB/G/PDMS films were characterized via ATR-FTIR and UV-Visible spectroscopy. It was found out that 1:3 ratio had the lowest resistivity of $1.615 \times 10^{3}$ with the optimum conductivity value $6.19 \times 10^{-4}$ $\Omega \cdot cm^{-1}$ while 3:1 ratio had the second lowest conductivity at $5.49 \times 10^{-4}$ $\Omega \cdot cm^{-1}$ with a resistivity of $1.82 \times 10^{3}$ $\Omega \cdot cm$ via multimeter testing. From four-point probe analysis, 1:3 ratio had the optimum conductivity value of $4.35 \times 10^{-6}$ S/m while the lowest conductivity value belongs to 2:1 at $3.69 \times 10^{-6}$ S/m. ATR-FTIR was also used to determine the functional groups contained within CB, G and PDMS. CB can be seen having peaks around 2700 – 3000 $cm^{-1}$, denoting the C-H stretching, PDMS at peaks of 1000 – 1100 $cm^{-1}$ which corresponds to Si-O-Si stretching, 1250 – 1260 $cm^{-1}$ of Si-$CH_3$ stretching and 800 – 850 $cm^{-1}$ for Si-C stretching. As for graphite, the G band of graphitic carbon could be spotted at around 1580 – 1600 $cm^{-1}$. UV-Visible spectroscopy spectra depicted the maximum wavelength values for samples ranging from 293 to 302 nm, showing $\pi$ - $\pi^*$ transition. This study is significant to observe the effects of ball milling process and the influences of incorporation of CB and G in improving the electrical conductivity of a silicone-based ECAs.

## TABLE OF CONTENTS