

UNIVERSITI TEKNOLOGI MARA

**MECHANICAL AND CONDUCTIVE PROPERTIES OF
SILICONE FILLED GRAPHENE TREATED WITH
SILANE COUPLING AGENT ELECTRICALLY
CONDUCTIVE ADHESIVE (ECAs)**

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

Graphene treated with silane-based silicone was successfully prepared for electrically conductive adhesive application via mechanical stirring process. The objectives of this study were to investigate the mechanical and conductive properties of various graphene loading (0, 1, 3, 5 wt%) filled silicone and determine the effect of silane treatment on graphene reinforcement in silicone electrically conductive adhesive different graphene/silane loading (0, 1, 3, and 5 wt%). Mechanical properties testing has been conducted via hardness test and tensile test whilst conductive properties testing using electrochemical impedance spectroscopy (EIS) and volume resistivity. For hardness testing, GR/APTES regardless of its loading have the higher value of hardness at 60. While as for tensile test, GR/silicone and silicone/GR/APTES show the increment of tensile strength value. Hence, it shows that properties of graphene itself are higher in strength since it does not affect when the pull-out test was carried out. 5% GR/APTES show the high value of tensile stress at 4.05 MPa compared to the untreated GR at 3.5 MPa. The increasing of the GR/APTES shown an improvement to the mechanical properties, due to the surface treatments of APTES itself giving better interaction. Other than that, electrical conductivity increased was found at $1.90\text{E-}08$ S/cm at 5% GR/APTES, when the percentage of graphene loading increased. This inverse trend is recorded with volume resistivity. The volume resistivity decreased when the GR loading increased, such as 5% GR/APTES was found at $1.10\text{E-}3$ Ohm.cm⁻¹. Overall, the incorporation of graphene/silane into adhesive improve the mechanical and conductive properties and the optimum value was found at 5 % GR/APTES.

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