ELECTRICAL, MECHANICAL AND ADHESION PROPERTIES OF SILICONE ELECTRICAL CONDUCTIVE ADHESIVES (ECAs) FILLED CARBON BLACK AT ELEVATED TEMPERATURE

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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.

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TABLE OF CONTENTS

ABSTRACT

Electrical and Mechanical Properties of Silicone Electrical Conductive Adhesive (ECAs) filled Carbon Black at Elevated Temperature

In this study, different formulation of silicone filled carbon black electric conducting adhesive were successfully introduced. Carbon black was treated with 3-aminotriethoxysilane to improve the surface adhesion by the grafting of amide functional groups on the surface of the carbon black. Silicone filled untreated and treated carbon black with 3-aminotriethoxysilane were prepared and investigated on various loading of carbon black (0%,5%,10% and 5%) on silicone ECAs using film casting method. The characterization was performed on the conductive adhesive film by using Fourier Transform Infrared Spectroscopy (FTIR), hardness and tensile testing. While for the electric property, electrochemical impedance spectroscopy (EIS) was investigated and Cole-cole plot was plotted. It was found that the conductivity of the adhesive conductive film was dependent on the carbon black loading. As the carbon black loading increased, the conductivity of adhesive conductive film was increased up to 10% of carbon black loading and decreased when at 15% of carbon black loading. This is due to the gap distance of interparticle of silicone and carbon black is high. The optimum formulation of electric conductivity of 10% loading of carbon black is 1.75E-08 Ω/cm. This is because, increasing carbon black loading in silicone, it will increase the conductivity of the film. The FTIR testing was conducted to confirm the surface modification of carbon black with 3-aminotriethoxysilane and amide functional groups was presence on the surface of the carbon black at 1549 cm^{-1}, 1250.7 cm^{-1}, 1126.6 $cm^{-1,}$ 976.16 cm^{-1} and 860.02 cm^{-1} corresponding to the N-H, SiO-H, Si-O-Si, C-N and C=C stretching vibrations of the amino groups (-R-NH_3^+), respectively. Furthermore, hardness testing also showed the result by increasing carbon black loading on the silicone, the hardness value also increased. This was supported by the tensile testing which the tensile strength of the silicone filled carbon black increased with increasing in the carbon black content. The Young modulus of the silicone filled carbon black also increased. The modulus increased until carbon black loading of 10% with the value are 0.24016 MPa, then decreased when carbon black loading at 15% of 0.21528 MPa. This is due to the addition of more carbon black into the conductive film. It will increase the stiffness and reduce the ductility of the film.