INVESTIGATION OF ADHESION BETWEEN MICROWAVE PLASMA TREATED EPOXY AND SILICONE

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INVESTIGATION OF ADHESION BETWEEN MICROWAVE PLASMA TREATED EPOXY AND SILICONE

by

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Figure 2.9 Opening of oxirane ring by nucleophile O− in SN2 mechanism (Morrison and Boyd, 1992). R represents a polymer chain.

Figure 2.10 Schematic of plasma induced selective etching on glass-filled polyphenol composite. Comparison between untreated and plasma treated polyphenol composite reveals great enhancement of surface roughness (Puliyalil et al., 2015).

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Figure 2.16 The structure and properties of epoxy (Petrie, 2006). \( n \) is number of repeating units of epoxy in polymer chain.

Figure 2.17 Etherization reaction between DGEBA epoxy and silicone (Ge et al., 2017). Number of monomers in silicone and epoxy are represented by \( m \) and \( n \), respectively.

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Figure 2.19 Adhesion between adhesive and substrate formed by (a) good and (b) bad wetting interface (Fourche, 1995).

Figure 2.20 Schematic represents presence of weak boundary layer on oxygen plasma treated polymer. LMWOM created on polymer exhibit different compatibility with metal coating and glue, respectively (Friedrich, 2012).

Figure 2.21 Reorientation of polar groups (red dots) of polymer chain from polymer surface towards the bulk and unmodified parts of polymer chains tend to expose to polymer surface during ageing (Mortazavi and Nosonovsk, 2012).

Figure 2.22 The XPS spectra of C1s spectra of epoxy (a) without modification and (b) air plasma modification for 360 s in air pressure of 94.7 kPa and power of 92.5 W (Hong et al., 2019).

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Figure 2.28 Tapping-mode AFM topographic image of nodular LMWOM on polypropylene film treated in air corona discharge (Strobel et al., 2003).

Figure 2.29 (a) Height and (b) phase images of epoxy blended with poly(ε-caprolactone) crystalline (Meng et al., 2006).

Figure 2.30 FTIR-ATR spectra of epoxy subjected to 24 and 48 hours hygrothermal treatment (Ulrich et al., 2015).

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Figure 2.32 TEM micrographs show fractures in epoxy composites (Gong et al., 2015).

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Figure 3.1 An overview of project methodology.

Figure 3.2 Chemical structures of (a) DGEBA and (b) o-cresol novolac.

Figure 3.3 Chemical structure of curing agent 2,4 toluene diisocyanate urone (TDI).

Figure 3.4 Chemical formulation of release agent, silicone.
Figure 3.5  Chemical structure of silicone. $n$ is the number of monomers of silicone.  

Figure 3.6  (a) Desposition of silicone liquid drop by an automated dispenser, (b) removal of automated dispenser from epoxy surface, (c) placement of a glass die on silicone drop and (d) formation of assembly of epoxy and silicone.  

Figure 3.7  (a) Optical photo of side view of glass die and silicone adhere to epoxy and (b) schematic representation of cross-sectional view of epoxy and silicone assembly.  

Figure 3.8  PVA Tepla GIGA 80 Plus microwave plasma chamber.  

Figure 3.9  Microwave system including plasma source of 2.45 GHz, waveguides and applicator (Lebedev, 2015; Liebel, 2008; Mehdizadeh, 2015).  

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Figure 3.11  Procedure of hydrophobic recovery studies including surface analysis, shear testing and reliability testing on plasma treated epoxy.  

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Figure 4.1  Comparison of XPS survey spectra of untreated epoxy and epoxy treated at plasma power of 500 W in oxygen flow rate for 1 min.