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Physical and adhesive properties of some materials made by 'Click' chemistry

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Physical and Adhesive Properties of Some Materials Made by "Click" Chemistry

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Certification

I, Nicolas Le Baut, declare that this thesis, submitted in fulfillment of the requirements for the award of Honours Master of Engineering by Research, in the Materials Engineering Discipline, University of Wollongong, is wholly my own work unless otherwise referenced or acknowledged. The document has not been submitted for qualifications at any other academic institution.

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Abstract

The aim of this work is to examine the physical and adhesive properties of a number of crosslinked polymers made by “click” chemistry, a technique, that has been explored thus far only in the context of drug discovery. The polymers were synthesised between copper and brass plates. Differential scanning calorimetry (DSC) and dynamic mechanical analysis (DMA) were used to measure the glass transition temperature (Tg) of these materials. The polymers were found to have unusually high Tg values, sometimes up to 60^{o}C higher than the curing temperature, depending on the cure time. The adhesives properties of these materials on brass substrates have also been examined using a fracture mechanics test, the double cantilever beam test (DCB). The adhesion was found to be very similar (sometimes higher) than that of some commercial epoxy systems. Finally, the copper-polymer interface was characterized using the surface enhanced Raman scattering (SERS) technique. SERS showed the presence of a triazole-based compound adsorbed on copper. The adhesion strength of these “click” polymers on copper substrates is believed to be function of the formation of the triazole-copper complex.

Abbreviations

DSC	Differential scanning calorimetry
DMA	Dynamic mechanical analysis
Tg	Glass transition temperature
DCB	Double cantilever beam test
SERS	Surface enhanced Raman scattering
Cu	Copper
Cu(I)	Copper ion (primary)
Cu(0)	Copper metal
Cu(II)	Copper ion (secondary)
$C0_2$	Carbon dioxide
$Kcalmol^{-1}$	Kilocalory per mol
H_2O	Water
O_2	Dioxide
CPMV	Cowpea mosaic virus
Fuc-T	Fucosyltransferases
CuI	Copper iodide
η	Viscosity
G_e	Equilibrium modulus
T_{cure}	Curing temperature
Tg_{∞}	Glass transition temperature for a fully cure system
TTT	Time-temperature-transformation
Tg_0	Glass transition temperature of the prepolymer
${}_{gel}Tg$	Temperature at which gelation and vitrification coincide
THF	Tetrahydrofuran
DMAP	4-Dimethylaminopyridine
TLC	Thin layer chromatography
Et_3N	Triethylammoniac
$Et_3N{\cdot}HCl$	Drochloride
EtOAc	Ethyl Acetate
Na_2SO_4	Sodium Sulphate

Mmol	Millimole
ML	Millilitre
NaN_3	Sodium azide
G	Gram
EtOH	Ethanol
°C	Degree celcius
NMR	Nuclear magnetic resonnance
^{1}H-NMR	Nuclear magnetic resonance of Hydrogen
^{13}C-NMR	Nuclear magnetic resonance of carbon 13
$CDCl_3$	Deuterated Chloroform
R_f	Resolution factor for chromatography
Mp	Melting point
δ	Chemical shift (in "Monomers synthesis" section, Chapter 3 and 5)
s	Single peak
d	Doublet peak
t	Triplet peak
H	Hydrogen
J	Coupling constant
Hz	Hertz
IR	Infrared
MS	Mass spectroscopy
m/z	Relative intensity
M	Molecular ion peak
Na	Sodium
HRMS	High resolution mass spectroscopy
Calcd	Calculated

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