Accepted Manuscript

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PII: S1359-8368(16)33071-2

DOI: 10.1016/j.compositesb.2017.11.010

Reference: JCOMB 5372

To appear in: *Composites Part B*

Received Date: 13 December 2016

Revised Date: 6 September 2017

Accepted Date: 2 November 2017

Please cite this article as: Suliga A, Hamerton I, Viquerat A, Cycloaliphatic epoxy-based hybrid nanocomposites reinforced with POSS or nanosilica for improved environmental stability in low Earth orbit, *Composites Part B* (2017), doi: 10.1016/j.compositesb.2017.11.010.

Cycloaliphatic epoxy-based hybrid nanocomposites reinforced with POSS or nanosilica for improved environmental stability in low Earth orbit.

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Abstract

The purpose of this study is to demonstrate the properties of novel nanocomposites, based on cycloaliphatic epoxy resin additionally reinforced with silicon-containing nanostructures (mono- or octa-functional POSS or nanosilica). The changes in properties are discussed for the varied combinations of cycloaliphatic epoxy with a curing agent (cycloaliphatic amine or anhydride) and the nanomodifier. The influence of modification on thermal stability, curing behaviour, morphology, surface chemistry, and topography were studied with TGA, DSC, ATR-FTIR, XPS and LCM. The results show that when POSS and/or nanosilica are incorporated to the cycloaliphatic matrix they influence curing behaviour and glass transition temperatures (T_g), where mono-POSS increases T_g and octa-POSS decreases it with respect to nanosilica. Mono-POSS produces silicon-rich surfaces but tends to agglomerate and increase surface roughness. Octa-POSS and nanosilica penetrate the polymer matrix more deeply and disperse more easily. From the selected modifiers, octa-POSS shows the highest thermal stability.

Keywords: Cycloaliphatic epoxy, Nanosilica, Polymer matrix composites, POSS, Environmental stability

Cycloaliphatic epoxy resins offer an improved environmental resistance in comparison with standard Bisphenol A or Bisphenol F diglycidyl ether epoxies (DGEBA and DGEBF) [1]. This is due to the absence of strongly UV absorbent chromophoric groups, such as unsaturated aromatic

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