

复合材料自修复体系的设计与玻纤负载催化剂的制备

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关键词: 复合材料 自修复 玻璃纤维 Karstedt 催化剂

聚合物基自修复材料是以聚合物为基体的, 在受外界作用后能做出自我诊断, 并能对裂纹或损伤进行一定程度修复的复合材料。自修复的概念于 20 世纪 80 年代提出, 最早应用于陶瓷基复合材料, 后来推广到聚合物基复合材料^[2,3]。

本文介绍聚合物基复合材料微损伤的一种新的自修复体系的设计, 见图 1。将 Karstedt 型铂催化剂, $\text{Pt}_2(\text{CH}_2=\text{CHMe}_2\text{Si})_2\text{O}_3$, 修饰在玻璃纤维的表面, 包裹着反应性有机硅单体的微胶囊埋置在玻璃纤维增强的聚合物基复合材料中, 当材料受到外力作用时产生裂纹并使胶囊破裂, 胶囊中的单体流入裂纹, 并随着裂纹的发展流向玻璃纤维表面, 在玻璃纤维表面的 Karstedt 催化剂引发下发生硅氢化反应, 原位交联聚合形成有机硅橡胶相, 从而修复裂纹, 恢复材料原有的性能, 达到自修复的目的。

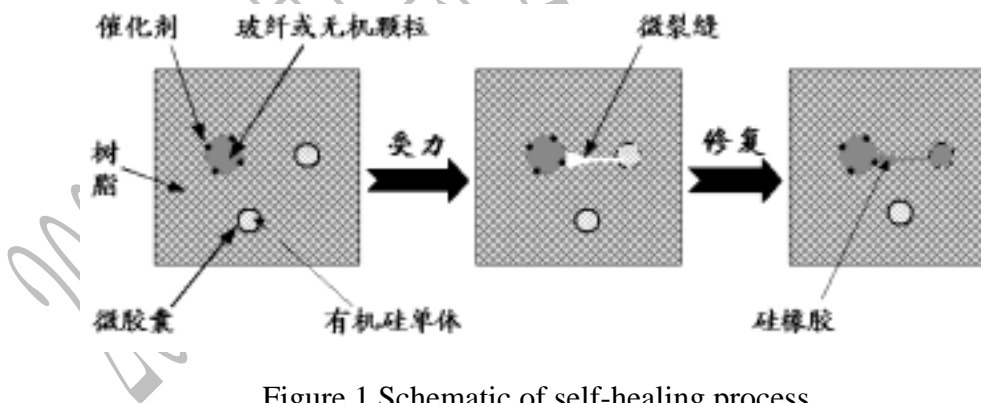


Figure 1 Schematic of self-healing process

按照自修复体系的设计要求, 本文制备了玻纤负载的 Karstedt 催化剂。将购入的三种玻纤在 600 灼烧 30 分钟, 除掉表面上的浸润剂。用硅烷偶联剂乙烯基三乙氧基硅烷 1% 水溶液浸泡玻纤 2 小时, 并同时搅拌。通过傅立叶变换红外和光学显微镜证明短玻纤表面较好的键合上了乙烯基。

在 50ml 圆底烧瓶内 ,放入六水合氯铂酸 5mg ,加一滴水溶解氯铂酸 ,再加 5ml 异丙醇 ,混合均匀。加入 A-151 乳液处理的短玻纤 0.2g , 80 回流 30min 后加入 0.05g 碳酸氢钠 ,继续回流 4h。取出玻纤 , 80 烘干 4h。即得到负载了 Karstedt 催化剂的短玻纤。原子发射光谱分析表明 :短玻纤表面的 Pt 含量为 1.65mg/g。

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A Novel Design of Self-Healing Composites and the Preparation of a Glass Fiber Supported Karstedt-Type Catalyst

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A novel design of self-healing polymer composite was reported. A Karstedt's catalyst, $\text{Pt}_2(\text{CH}_2=\text{CH})_2\text{Si}_2\text{O}_3$, was modified onto the surface of glass fiber. The microcapsules containing reactive organo-silicone monomer were embedded in the polymer matrix. When the composite was engaged by the forces and induced the cracks, the microcapsules will break up, and the monomers will flow along with the development of the cracks. When the monomer contacts with the catalyst on the surface of glass fiber, it will polymerize and crosslink to form rubbery phase, which will resist the further development of the cracks. Thus, self-healing is realized. According to such a design, a glass fiber supported Karstedt-type catalyst was prepared by coordinating platinum at the surface of the short glass fiber. The platinum's content is 1.65mg/g determined by atomic emission spectrometry.

Keywords : Composite Self-healing Glass fiber Karstedt catalyst