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Investigation of cyanoacrylate adhesive bond curing and durability using Raman spectroscopy and electrochemical impedance spectroscopy

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Cyanoacrylate (CA) polymerization is normally triggered by traces of basic substances at the adhesive/substrate interface resulting in rapid formation of large molecular weight polymers. However there are some disadvantages, for instance, increasing the bond gap from 10 microns (zero gap bonds) to 100 microns can increase bond fixture time from a few seconds up to several minutes, sometimes limiting their service capabilities. The aim of this work is to use Raman spectroscopy and other surface analytical and chemical laboratory techniques to gain improved understanding of the processes responsible for performance limitations of such adhesives. Raman will be employed to provide insights into the rates and mechanisms of the interfacial CA polymerization process, which are known to be independent of bulk polymerization processes. In addition, the examination of the time-dependent and spatial behavior of EIS data in conjunction with a mathematical model based on the diffusion of monomeric and/or polymeric species through the adhesive volume will aid our understanding of the polymerization processes occurring in various regions of the adhesive bond including the edge and the bulk material. By studying the effects of chemical and physical variations the fundamental questions regarding the degradation of adhesive joints by environmental stress will be addressed thereby enhancing our knowledge of the hydrolytic stability of CA adhesive bond.

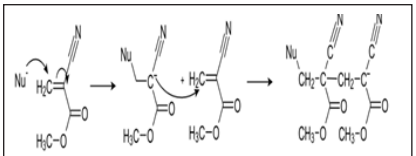

Figure-1: Reaction mechanism for the polymerization of ethyl cyanoacrylate.

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