

*Review*

## Recent Developments in Halogen Free Flame Retardants for Epoxy Resins for Electrical and Electronic Applications

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**Abstract:** The recent implementation of new environmental legislations led to a change in the manufacturing of composites that has repercussions on printed wiring boards (PWB). This in turn led to alternate processing methods (e.g., lead-free soldering), which affected the required physical and chemical properties of the additives used to impart flame retardancy. This review will discuss the latest advancements in phosphorus containing flame retardants for electrical and electronic (EE) applications and compare them with commercially available ones. The mechanism of degradation and flame retardancy of phosphorus flame retardants in epoxy resins will also be discussed.

**Keywords:** epoxy; fire retardant; phosphorus; printed wiring boards; composites

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### 1. Introduction

In the 21<sup>st</sup> century, polymer derived products are present everywhere in our daily life. Composite materials in particular have slowly replaced steel and aluminium alloys in a wide range of applications over the past decades [1–2]. Composite materials consist of an organic polymer matrix reinforced with either glass, carbon, aramide or natural fibres. In 2009, the estimated production of glass-fibre reinforced plastics in Europe was 815 kt [3]. Composite materials offer great physical, thermal, chemical and mechanical properties, while maintaining low density, high specific stiffness and

# Epoxy Resin Technology Developments Since 1979

## Chemical Technology Review

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## **Epoxy Resin Technology Developments Since 1979 Chemical Technology Review:**

*Structural Adhesives* S.R. Hartshorn, 2012-12-06 Adhesives in general and structural adhesives in particular are the subjects of much academic interest as well as commercial importance Structural bonding as a method of joining offers a number of advantages over mechanical fastening However in order to achieve satisfactory results the proper adhesive must be selected and the appropriate bonding procedures followed The purpose of *Structural Adhesives Chemistry and Technology* is to review the major classes of structural adhesives and the principles of adhesion and bonding as these relate to structural joints Each chapter provides an overview of the topic under discussion with a list of references to the relevant literature In addition to describing the chemistry involved other aspects of structural adhesive technology are covered such as formulation testing and end uses Some structural adhesives especially epoxies and phenolics have a long history of successful use and are now widely employed Others such as the structural acrylics and cyanoacrylates are beginning to gain industrial acceptance Urethanes and anaerobics have limited but important uses while high temperature adhesives are still largely in the research and development stage **Monographic Series** Library of Congress, *Library of Congress Catalogs* Library of Congress, 1983

**Plastics for Electronics** M. Goosey, 2013-04-17 Polymeric materials are widely used during nearly all stages of the manufacturing process of electronics products and this book is intended to give an introductory overview of the chemistry properties and uses of some of the more important classes of materials likely to be encountered in these applications It is intended to serve primarily as an introduction to the use of polymers and plastics in the processing and manufacture of electronic and electrical components and assemblies With no in depth knowledge of polymers assumed the book is ideal for engineers and researchers working in areas where electronics and polymer technology overlap There are also numerous references for those wishing to delve deeper The first edition of this book was published in 1985 and since then there has been an unbelievable change and growth in the electronics industry Much of this has been made possible by the continued development of new and improved polymeric materials In some areas the polymers used have changed markedly whereas in others there have been continued improvements to the same basic materials Consequently this second edition includes new chapters detailing the materials which have emerged more recently Chapters covering the same topics as the original version have been extensively rewritten and updated often with the assistance of current international experts In the last few years much work has been carried out on the development and use of special polymers that have important properties in addition to those normally associated with conventional polymers This edition therefore includes a chapter that introduces one particular group of materials exhibiting these special properties the ferroelectric polymers The book also includes new chapters on high temperature thermoplastics or engineering plastics as they are sometimes known and their use in so called moulded interconnect devices where the polymer is used to provide a much wider range of functions than has been possible using a more conventional approach This new edition also has a wider international coverage with chapters by

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