GWENT GROUP

ADVANCED MATERIAL SYSTEMS

NEW DEVELOPMENTS IN POLYMER THICK FILM PASTES

Thick Films

Thick Films can be categorised into two broad groups. Those systems that are 'fired' at HIGH TEMPERATURE 600ºC and above, and those systems that are 'cured' at LOW TEMPERATURE, 250ºC and below.

High Temperature Systems

These systems are based on resinous or polymeric binders that are essentially thermoplastic in nature. Their function is to prevent the metal particles from 'seeding' out and to render the rheology of the ink suitable for the specified printing operation. The binder is designed to 'burn out' when the ink is fired leaving the metal particles to form a conductive layer. A small amount of glass or ceramic material is incorporated to allow the conductor to adhere to the substrate and this is designed to flow at or slightly below the firing temperature. The 'firing' temperature is selected to ensure that the metal particles will sinter to produce a continuious film with good ohmic contact.

Low Temperature Cure Systems

These systems are based on resinous or polymeric binders that may be thermoplastic or thermosetting in nature. In addition to preventing 'seeding' and acting as a rheology modifier, the polymer remains in the cured film acting as the adhesive component between the conductor material and the substrate.

i) Systems based on non-reactive resins and polymers do not 'CURE' but dry by solvent evaporation to give a coating.

ii) Systems based on reactive or functional polymers 'CURE' to a cross linked network that can have enhanced chemical and physical properties.

Reactive Systems

Two pack:

They are composed of two functional materials that will react together to form a cross linked network eg Epoxy–Amine and Epoxy-Anhydride systems. The relatively short 'POT LIFE' of these systems is a critical factor in their use. This necessitates the two components being mixed together immediately prior to use and restricts the time available for application of the mixture.

One pack: Refrigerated storage

These materials are in essence mixed two pack systems that are stored at < -22ºC to quench the reaction and increase the storage life. Once exposed to room temperature they are susceptible to the same use criteria as the Two Pack Systems described above.

One-pack: Room temperature stable, cross-linkable systems.

A ONE-PACK room temperature stable system, capable of being printed without short term 'Pot Life' concerns, while retaining the ability to react to produce a coherent, resistant film when heated at relatively low temperatures. This would seem an ideal solution.

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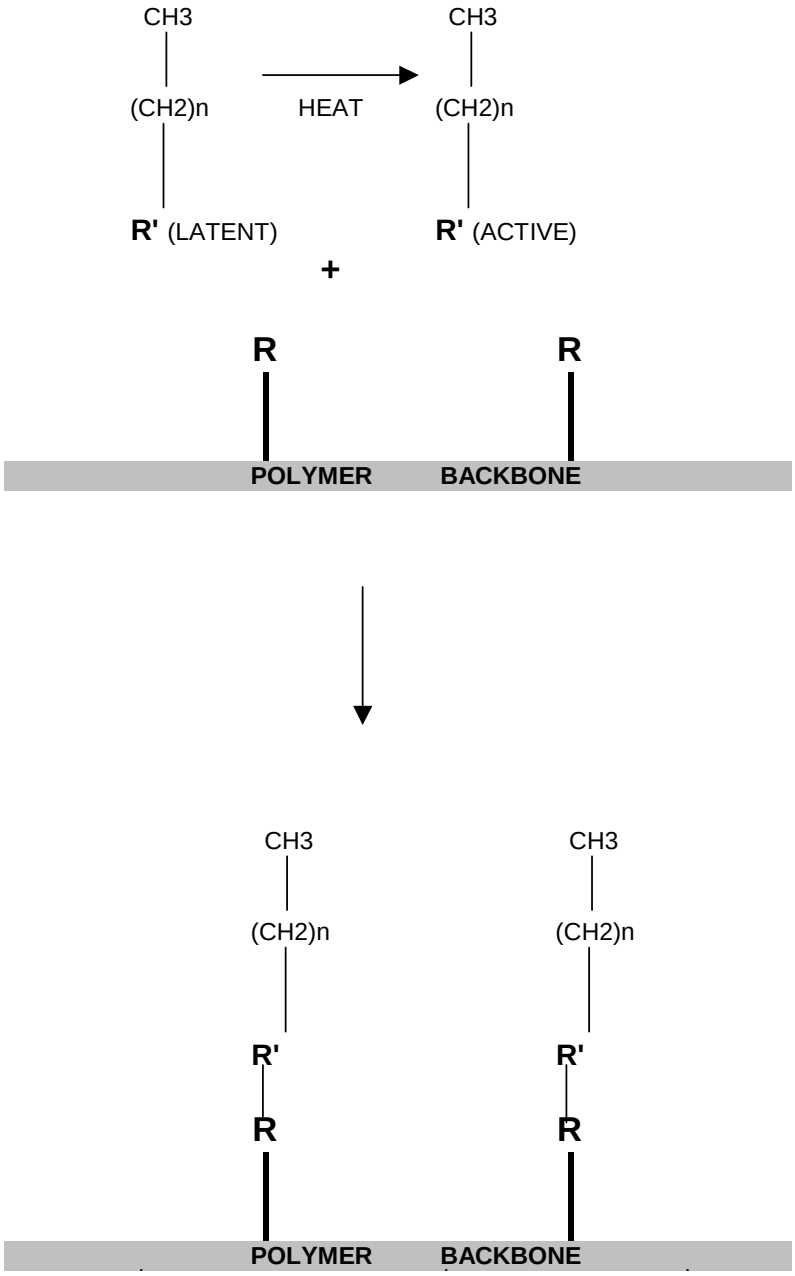
NEW DEVELOPMENTS AT GWENT ELECTRONIC MATERIALS LTD.

Heat Curable Polymeric Inks

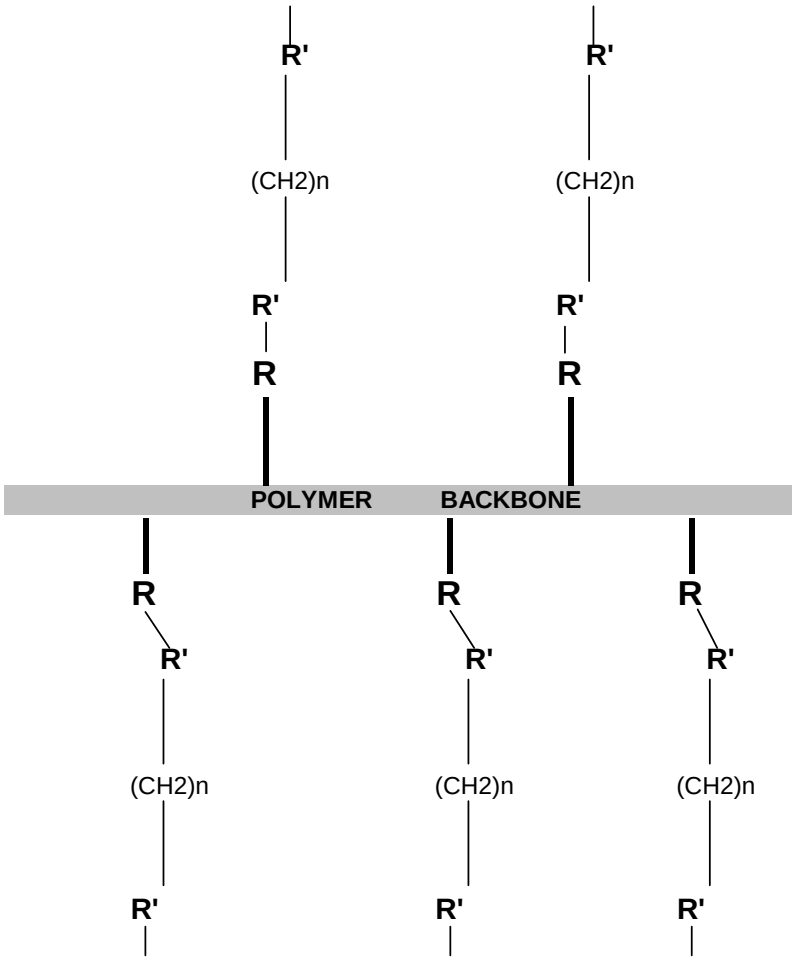
We at GWENT ELECTRONIC MATERIALS have developed a range of cross-linkable systems based on polymeric materials with latent or masked reactivity. They combine long term room temperature stability with the ability to form a cross linked coating when 'CURED' at temperatures between 90ºC and 200ºC.
These cross-linked polymer systems confer improved abrasion, chemical and environmental resistance to the film.

By chosing as co-reactant a polymeric species with pendent reactive groups spaced along the polymer backbone it is possible to produce a high molecular weight polymer capable of film forming on curing.



(FIG 2)

By using reactants that are polyfunctional (have two or more reactive groups per molecule), a high molecular weight cross-linked network can be formed in-sittu.



(FIG 3)

A coherent film formed from this type of structre will have improved chemical and physical properties compared to films formed from the more linear polymers traditionaly used in PTF inks.

COMMERCIAL APPLICATIONS

GEM have produced inks and pastes for a number of different PTF market applications that utilise the unique range of properties obtainable with these systems.

Electro Luminescent Inks

It is possible to achieve cure schedules of 3 minutes at 130ºC with these systems and this together with the excellent ADHESION and FLEXIBILITY on ITO substrates means they can be used as the base for Conductive Inks, Insulation Inks, Dielectric Inks and Phosphor Inks for the manufacture of electro luminescent lamps.
The excellent chemical and environmental resistance conferred by the cross-linked system means that, providing the electro luminescent lamps are laminated before use, the normal protective UV-Cure layer can be dispensed with in the construction of the lamp.
(for details see data sheets on the GEM range of Electro Luminescent Inks)

Conductive and Thermal Adhesives

The ability of these systems to adhere to surfaces such as untreated Aluminium, sputtered or electro plated metal surfaces, including Gold, allows them to be used in electrical and thermal conductors on a variety of substrates. Cure temperatures for the inks vary with type ranging from 90ºC to 180ºC and hence are suitable for heat stabilised polymeric substrates including Polyester and Polyimide

In-vivo and In-vitro Bio-Sensors

These systems can be used as sensor inks designed for in-vivo and in-vitro applications. The excellent physical and chemical resistance properties mean that they can withstand the harsh environment associated with in-body sensors and electrodes. Again cure temperatures are in the range 90ºC to 180ºC dependent on polymer type. Hence the inks are capable of being used on relatively inexpensive substrates making them suitable for the disposable sensor market and in particular Medical Diagnostic, Environmental and Agri-food applications.

Low Temperature Cure, Solderable Conductor Inks

Using the high Glass Transition Temperatures that can be obtain with highly cross linked polymer systems Silver based Inks can be formulated that will accept manual soldering using a Low Melting Point (LMP) solder.
Cure temperatures of 150ºC - 180ºC means that the ink to be printed onto PCB's and PWB's

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