

## **Controlled Thermoplastic Polymer Adhesion to Materials Used in Electronics**

Polymer encapsulation has been a key technology in electronic packaging for many years. The majority of the experience within the electronics industry with polymer encapsulation has been with thermoset polymer materials that can be transfer moulded or “potted” around the component, while still in a liquid state before curing. Thermoset materials enable good wetting of the component surfaces, such that they flow into confined areas and give excellent adhesion to most materials. Such encapsulations produce fully enclosed devices that are mechanically secure, act as filter for contaminants, prevent electro-chemical corrosion due to exposure to the environment and provide mechanical support.

A major disadvantage involved in the use of thermoset polymers is that the electronic waste produced cannot easily be recycled. This feature is now more critical because of European legislation (the WEEE directive) that has recently come into force to reduce the amount of electronic waste dumped to landfill. To address this problem a novel process has been developed for manufacture of electronic products which involves embedding the electronic components in thermoplastic polymers, as an alternative to the conventional practice of soldering them to a thermoset polymer/glass fibre composite circuit board. The process may involve the use of compostable or soluble polymers which will permit easy separation of the electronic components and the circuit board material at end of life. This separation into waste streams facilitates recycling. In addition the energy costs of soldering are avoided.

The use of thermoplastic polymers in electronic products up to now has been mostly restricted to the casings, and their properties as encapsulants have not been much studied. Thermoplastics have higher viscosities and higher processing temperatures as compared to thermosets. Also, their interactions with and adhesion to in-mould insert material surfaces during and after injection moulding have not been studied in detail. This project has the aim of investigating the adhesion and associated interactions of various thermoplastic polymers with materials used in electronics such as metals (tin, copper etc.), ceramics, and other polymers. Adhesion measurements will be supported by surface analysis (XPS, SIMS), wetting angle measurements, SEM and microscopic inspection and polymer microstructural analysis techniques.

The move to use of thermoplastics for electronic assemblies, with the consequent environmental benefits, cannot happen at the expense of product integrity and reliability. The investigation therefore also aims at establishing the key process parameters that must be controlled in manufacturing of electronic products with a thermoplastic substrate.

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