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Industrial Member Report Summary – Key Findings for Industry

Surface Modification of Thermoplastic Materials Using Lasers for Improved Wettability and Adhesion

TWI Core Research Programme

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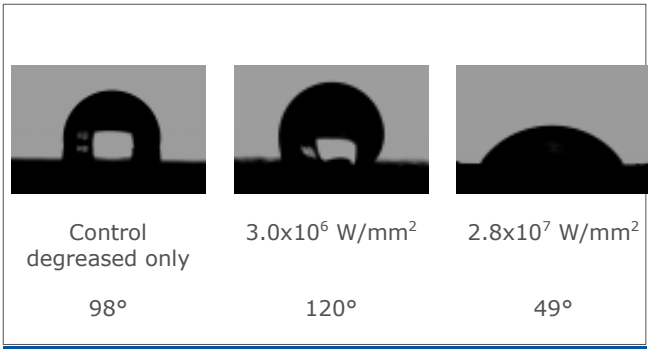
Industrial need

For successful adhesion to a thermoplastic surface, suitable surface treatment is most often required. This is one of the major factors in controlling the surface energy, achieving good wettability and improving long term durability. Laser treatment offers ease of application (hand held systems have been developed), zero consumables, dry processing with no requirement for pre or post processing, no requirement for an enclosed chamber and it can be applied to precise locations down to the micron scale or conversely for wide area coverage in relatively harsh environments. This study assesses the characteristics and performance of laser treated plastics surfaces.

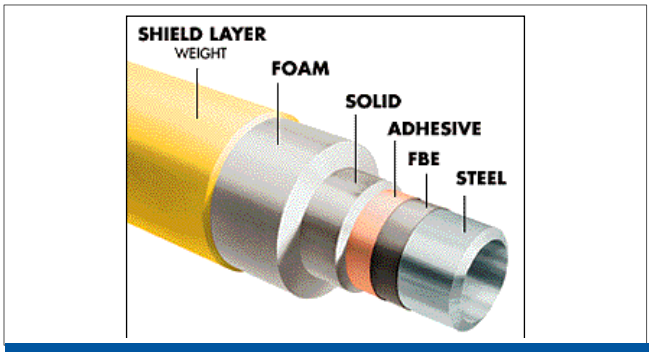
Key findings

Laser surface treatment carried out on polyetheretherketone (PEEK) and polypropylene (PP) led to the major findings:

- Laser surface treatment provided an increase in surface energy of PEEK, and an improvement to surface wetting for water based liquids. This has potential application for medical implants and for modifying liquid flow in microfluidic devices
- The bond strength between two PEEK parts using a cyanoacrylate based adhesive was improved by up to a factor of 13 over a control that had no surface treatment.
- Laser surface treatment could be used to provide an increase or decrease in surface energy of PP and an increase or decrease in wettability of the surface.
- The bond strength between two PP parts using polyurethane based adhesive, was improved by a factor of 10 over the control that had no surface treatment. This change in performance was retained after the treated surface had been left open to the atmosphere for five weeks after treatment. This is potentially applicable to the bonding of PP to PU for joints in insulated oil or gas pipelines.



Contact angle measurements: water droplets on PP treated at different laser intensities



Typical five layer polypropylene insulation system. The outer three layers are polypropylene

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