MONASH University

MONASH INNOVATION

UV LIGHT-TRIGGERED SELF-HEALING COATINGS

Photo-reversible cross-linked polymers for acrylate/methacrylate coatings. These polymer coatings can be applied at ambient temperature using UV light stimulus. In the event of a scratch or other damage to the surface, the polymer coating can then 'self-heal' in response to specific UV irradiation.

- **Small amount of cross-linker required (low mole %**
- **Separate cross-linking process step not required**
- **Ambient temperature immobilization of the coating (through reduction of glass transition temperature)**
- **Applicable to and makes use of commercially available monomers**
- **Can be combined with heat-associated techniques**

THE CHALLENGE

Polymer coatings play a crucial role in product life. Alteration of such coatings can cause loss of functionality such as in the case of ophthalmic lenses or loss of product aesthetics, for example in the case of motor vehicles.

Current techniques to repair damaged and scratched coatings do not satisfy industry and consumer requirements for the following reasons:

- The end product is not transparent
- They are limited to a single heal at any on location
- They require high temperatures to take effect, which can be difficult to achieve and can negatively impact the substrate

The inability to provide satisfactory repair to a polymer coating can result in demand for replacement of the item, attracting additional cost and offering a non-sustainable approach to the problem.

In addition, the application of polymer coatings typically require high temperatures. The amount of cross-linker needed can be high and an additional cross-linking step is usually required.

There is a clear need for a polymer coating application system combined with 'self-healing' properties that can be achieved at low temperature and low cost.

THE TECHNOLOGY

Our researchers have developed new photo-reversible, self-healing polymers and processes to form acrylate-based coatings induced by UV light stimuli.

These photo-self-healing polymers remain transparent and can be healed several times at the same location. No further additive required for the self-healing.

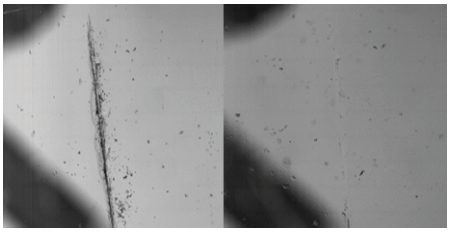
Our patented one step low-temperature (ambient) process uses immobilized and co-polymerised acrylate monomers onto a substrate with specific cross-linking agents. The cross-linking agents contain sub-units that reversibly dissociate in response to irradiation by specific UV light. This allows for polymerisation / depolymerisation as needed, to 'self-heal' damage to the surface of the coating multiple times.

We have demonstrated the ability of our system to 'heal' a surface defect in acrylate coatings, through irradiation with specific UV wavelengths, allowing some of the polymer to flow into the area of interest and re-set, thereby 'healing' the damage (see Fig.1).

The process has been successfully carried out with various acrylate derivatives such as butyl methacrylate, methyl acrylate, hexyl methacrylate and ethyl acrylate monomers. This demonstrates that commercial monomers can be used, with low additions of our crosslinker.

This technology presents the opportunity to develop a range of new acrylate polymer coatings that incorporate self-healing photo-stimulated healing technology.

A



B

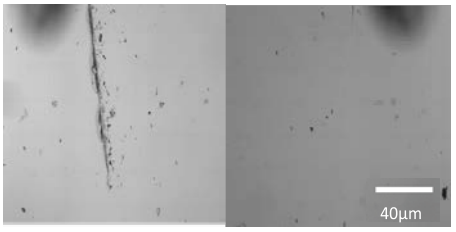


Figure 1: Optical micrograph of scratched (left) and healed coatings (right) formed by co-polymerising our photo-degradable dimer with (A) hexyl methacrylate monomer and (B) and ethyl acrylate monomer.

THE OPPORTUNITY

Monash seeks a partner to further develop this technology to the point of a commercial product and process.

The Monash Research team including Dr Kei Saito and Prof George Simon has extensive experience in green chemistry, polymer chemistry, supramolecular chemistry and polymer engineering with a particular focus on controlled polymerisation- depolymerisation, curing methods, polymer blends and thermosets, and polymer characterisation and properties.

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