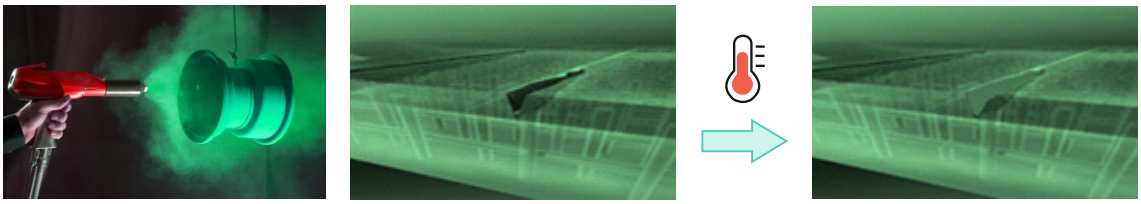
Multi-functional powder coatings - Self-healing by click chemistry

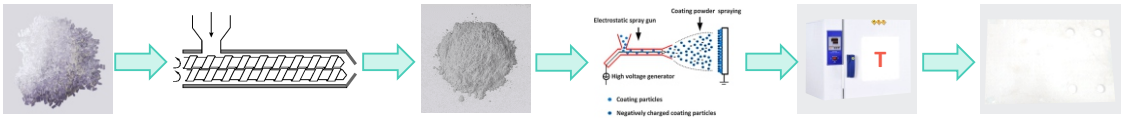
State of the art and motivation

Powder coatings have crucial advantages over solvent- or water-based liquid coatings:

They are manufactured and applied solvents free, usually have no emissions during the curing process, their overspray is recyclable, and high coating thicknesses for superior corrosion protection can be applied in a single process step. The integration of an additional self-healing function into powder coatings opens up the oportunity of repairing minor damage to the coated surfaces that occurs during production, transport or operation of the components, or as a result of environmental impacts, directly on site and thus reducing the processing related waste as well as extending the service life of a coating.



https://www.campbellfieldpowdercoating.com.au/ *https://www.technologyreview.com/2007/08/15/271470/self-healing-plastic/*



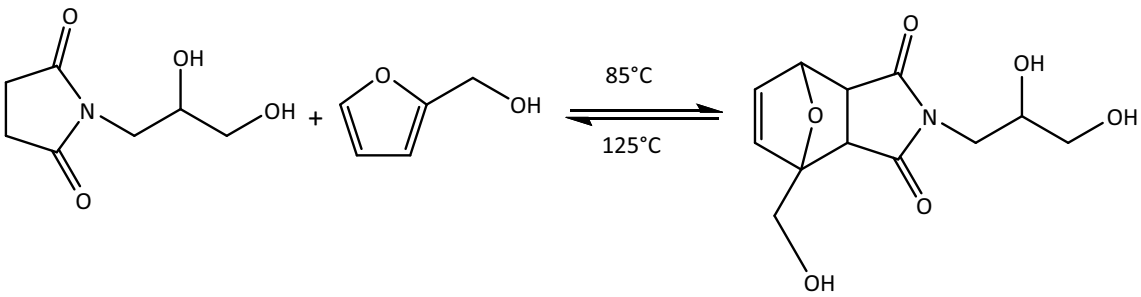
Starting materials Pre-mixing | Melt homogenization | Milling/sieving Grinded powder | Electrostatic application | Film formation and curing | Coated product

Powder coating fabrication and production of powder coated components

Example:

Self-healing (SH) via Diels-Alder reaction

- Introducing a Diels-Alder adduct as a healing agent (HA) into the powder coating formulation
- Provide healing ability using heat induced healing via wide range of temperature based on the Diels-Alder reaction condition

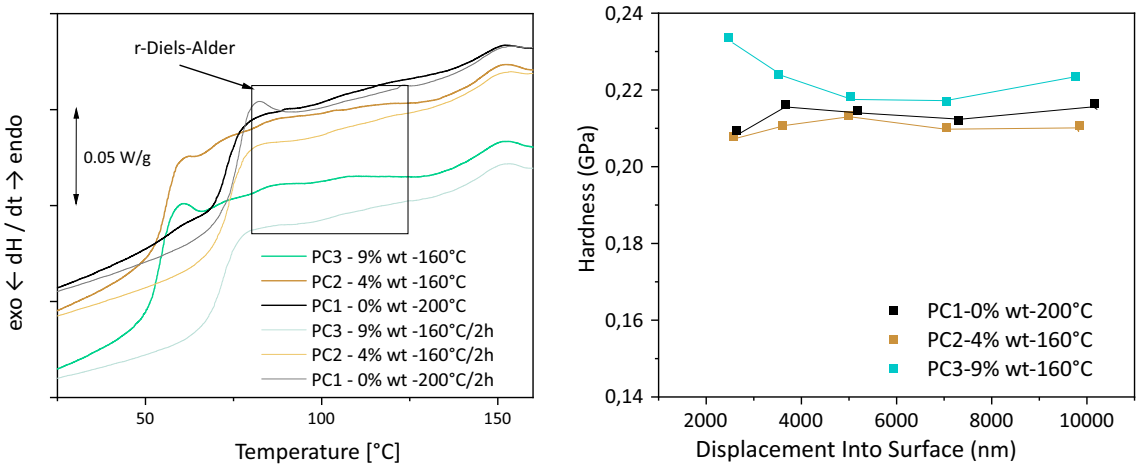


Diels-Alder retro Diels-Alder

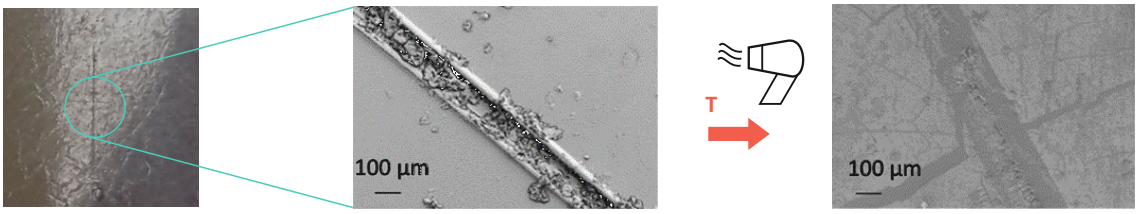
Furan-maleimide adduct as an example of a SH agent

Example:

SH polyurethane powder coating based on uretdione crosslinker and polyester as matrix components

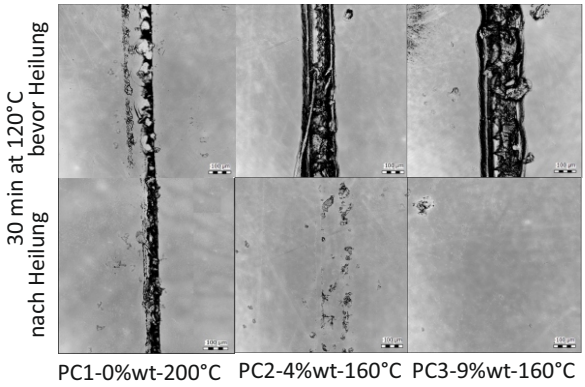


DSC (left)and DSI results (right) of uretdione based coatings containing 4 and 9% wt of the healing agent



Advantages

- Healing reaction proceeds at a reasonable speed starting from 80°C
- An additional catalytic effect of the HA leads to lowering of the curing temperature
- Improvement of coating hardness by HA
- Repeatability of the healing effect at the same spot (given example: proven at least 10 x)



Powder coating film after healing for 30 min at 120°C

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