

A NOVEL DISULFIDE-CONTAINING MONOMER FOR DYNAMIC PHOTOCURABLE COATINGS

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Abstract

Photopolymerization is a well-established technology that has gained importance over the past years for its environmentally friendly and sustainable features. Thanks to the low-energy need and fast-curing processes, photocurable materials are nowadays one of the main choices in applications such as coatings production. Despite excellent surface and bulk properties, the non-recyclability of crosslinked coatings has been recognized as an issue by several organizations, due to the increasing attention to environmental regulations. Dynamic covalent networks (DCN), combining the benefits of thermosets and the re-processability of thermoplastics, have acquired relevance during the last few years as a possible solution. Examples of DCN chemistries are: esters, Diels-Alder adducts, imines, and disulfides^[4]. Indeed, crosslinked photocured networks containing linear disulfides have attracted a lot of interest due to the peculiar properties and responsiveness of S-S bonds^[1], which make them suitable for several applications, chief among them self-healable materials^[2,3].

In this work, a novel disulfide containing diacrylate monomer (DSDA) was synthesized, introduced into a photocurable formulation, and cured leading to the production of a clear coating having a T_g of 84°C. The photopolymerization kinetics of the monomer was studied through real-time FTIR, highlighting a fast and complete conversion. High acrylate conversions were reached even in the absence of a photoinitiator, demonstrating DSDA self-initiating capabilities thanks to disulfide photocleavage and subsequent thiyl radicals generation. Thanks to the presence of S-S bonds in the cured network, self-healing of surface scratches could be easily achieved with a short thermal treatment^[5], thus proving the dynamicity of the designed network and paving the way toward a wider range of applications.

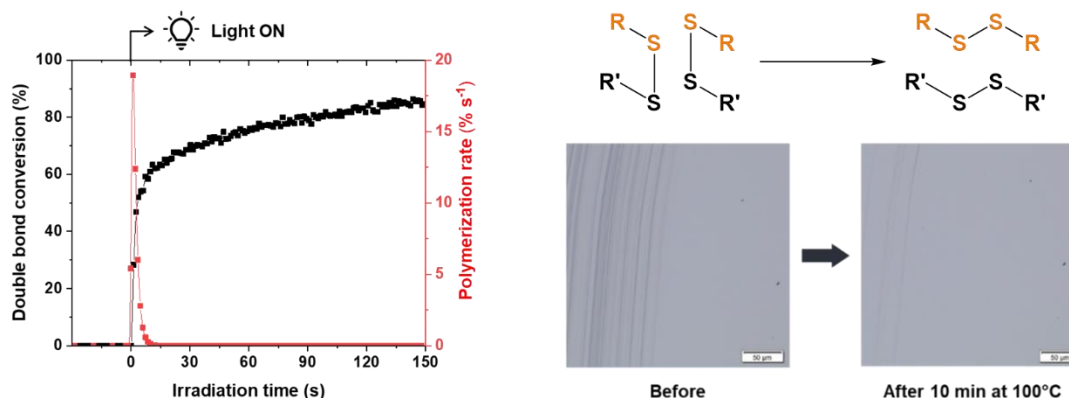


Figure 1: Photocuring kinetics of DSDA (left) and self-healing of surface scratches in DSDA coatings (right)

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