

PRODUCTION OF PHU COATING AND FOAMS

VIA NEAR-INFRA-RED IRRADIATION

Philibert Lenormand¹, Didier Gignes², Patrick Lacroix-Desmazes¹, Jacques Lalevée³, Sylvain Caillol¹, Christine Joly-Duhamel¹, Julien Pinaud*¹

¹ ICGM, Université Montpellier, CNRS, ENSCM, Montpellier, France

² ICR, Aix-Marseille Université, CNRS, Marseille, France

³ IS2M, Université de Haute-Alsace, CNRS, Mulhouse, France

Polyhydroxyurethane (PHU), obtained from the reaction of cyclocarbonates and amines, represent an eco-friendly alternative to conventional polyurethanes because their synthesis relies on CO₂-based precursors and does not involve toxic isocyanate compounds. However, the low reactivity of the cyclocarbonate aminolysis to form PHU represents a major drawback, particularly for industrialisation¹. Although the reaction can be accelerated in the presence of catalyst or by heating using oven there is still a gap of reactivity between isocyanate-alcohol and cyclocarbonate-amine additions. To overcome the lack of reactivity between cyclocarbonates and amines, we thus propose to use the photothermal effect generated by some compounds absorbing in the Near-Infra-Red (NIR) region. Indeed, photothermal effect, which consists in the production of heat at local environment by some metallic nanoparticles or organic dyes under NIR radiation, has proven very effective for increasing reaction kinetics, particularly for the synthesis of PU thermoset². As NIR sensitive compound we chose the organic dye IR-813 (Figure 1) because of its commercial availability and its good solubility in organic resins. It was added to a formulation composed of trimethylolpropane tris(2-chloroisocyanate) (TMPTC) and 1,5-pentanediamine and curing of the formulation under NIR light (805 nm) was then studied. Various parameters were varied such as the amount of heater or intensity of irradiation and their influence on gel time and maximum temperature reached were evaluated. Then, the best system was used for the production of PHU coatings and foams.

References

1. Carré, C.; Ecochard, Y.; Caillol, S.; Avérous, L. *ChemSusChem* 2019, 12 (15), 3410–3430.
2. Haas, K. M.; Lear, B. J. *Chem. Sci.* 2015, 6 (11), 6462–6467.
3. Bonardi, A.-H.; Bonardi, F.; Morlet-Savary, F.; Dietlin, C.; Noirbent, G.; Grant, T. M.; Fouassier, J.-P.; Dumur, F.; Lessard, B. H.; Gignes, D.; Lalevée, J. *Macromolecules* 2018, 51 (21), 8808–8820.

