

NIPU and NIPUH: Polyurethanes made from carbon dioxide instead of isocyanates

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Isocyanates are beside polyols the main compound for synthesis of polyurethanes and due to the convenient chemistry and adoptability of isocyanates, it is possible to formulate reactive or not reactive PU for almost any purpose. Unfortunately, isocyanates might be harmful and need harmful compounds for their production. All alternative preparation routes are by far not as versatile. In addition it is the question “How to use carbon dioxide as carbon source for materials to reduce the amount of greenhouse gases in the atmosphere”?

Therefore, we worked on two routes for the preparation of PU utilizing carbon dioxide instead of isocyanates. The urethane carbonyl originates from carbon dioxide and the nitrogen from an amine.

Non isocyanate polyurethanes (NIPU) are prepared from dimethylcarbonate accessible from carbon dioxide. First a transesterification of one methoxy is carried out by the polyol, after that the second methoxy reacts with the selected amine. By this the urethane group is formed in a condensation reaction.

The other route is the preparation of hydroxypolyurethanes (NIPUH) by the addition of amines to cyclic carbonates. We improved the synthesis of the cyclic carbonates from carbon dioxide significantly without the need of high-pressure equipment. The obtained materials can be cured by amines and processing as well as resulting materials properties are very similar to the conventional reaction between isocyanates and polyols. By this way e.g. two component PU adhesives are accessible, and the bonding properties will be shown.