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1. Main Research Topics Chemical Recycling of Polyurethane Currently, chemical recycling of polyurethane (PU) products remains a major challenge. Conventional degradation methods often suffer from uncontrollable side reactions, making it difficult to recover the original raw materials in high yield. As a result, practical implementation of closed-loop or horizontal recycling—where recycled materials are used to produce products of the same quality—has not yet been realized. In this study, we have developed a novel depolymerization process that uses carbonic acid, generated from water and carbon dioxide, as a catalyst. This method enables the quantitative recovery of reusable amines and polyols from model polyurethane without forming any unwanted byproducts. Key features of our process include: • Use of carbonated water as the catalyst—extremely low environmental impact • Carbon dioxide naturally evaporates after the reaction, eliminating the need for a neutralization step • The reaction proceeds under mild conditions, close to room temperature and atmospheric pressure We have further applied this technique to commercial polyurethane foam (PUF) products with practical formulations. Using the recovered amines and polyols, we successfully regenerated PUF, thereby achieving complete horizontal recycling of polyurethane materials. This research not only contributes to sustainable materials circulation, but also provides a highly practical technological platform for companies aiming to develop environmentally friendly products and reduce production costs. The diagram illustrates a circular process for chemical recycling. It starts with 'Plastic' (represented by blue cubes) which undergoes 'Hydrolysis' (indicated by a red arrow) to become a 'Hydrolyzed product' (represented by a flask with green liquid). This product then undergoes 'Separation' (indicated by a blue arrow) to yield 'Raw Chemicals' (represented by two test tubes, one blue and one orange). These raw chemicals are then used in 'Remanufacturing' (indicated by a green arrow) to produce new 'Plastic'. Conceptual Diagram of Chemical Recycling This diagram details the experimental process. It begins with 'Waste' entering a 'Reactor'. The process involves 'Heating, Pressurizing' with 'H₂O, CO₂'. A note states: 'Hydrolysis with carbonic acid, no environmental burden.' The reaction produces an 'Aqueous solution' and releases 'CO₂'. A note states: 'CO₂ volatilizes upon depressurization, neutralization is unnecessary.' The aqueous solution is then processed to yield 'Amine' and 'Polyol'. A note states: 'No by-products, low purification cost.' A final note at the top right states: 'H₂O and CO₂ are reusable.' Arrows indicate the flow of materials and the reusability of water and carbon dioxide.		
2. Keywords Chemical Recycling, Polyurethane, Carbon Dioxide, Building a Sustainable Society		
3. Remarks and Websites Patents WO2025017988A1 Method for polyurethane foam Topic https://www.pu-forum.com/en/lecturers/#session2 researchmap : https://researchmap.jp/motokucho Laboratory : https://www.cms.nagasaki-u.ac.jp/intro/organization.htm		