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Polymer Synthesis and Degradation toward Efficient Use of Less Utilized Carbon Resources

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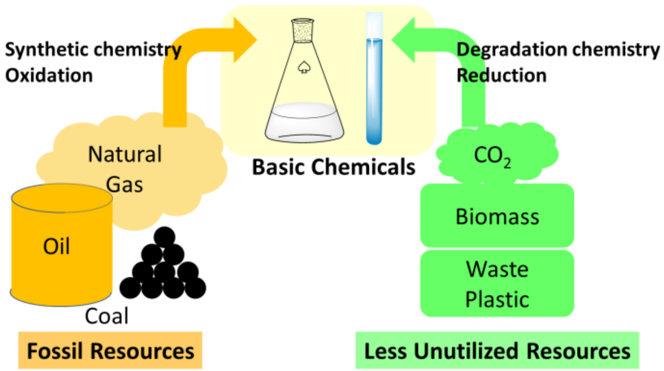
In addition to conventional fossil-based feedstocks, a wide range of alternative carbon sources are attracting increasing attention as part of the transition toward more sustainable chemical processes. These underutilized carbon sources include carbon dioxide, biomass, and plastic waste. Among them, the recycling and upcycling of plastic wastes have emerged as a particularly pressing and promising research area, driven by both academic interest and industrial demand. While significant advances have been made in the mechanical and chemical recycling of certain thermoplastics, the effective recycling of thermosetting plastics remains a formidable challenge due to their irreversible cross-linked networks. In this presentation, we introduce our recent efforts in synthesis and degradation of polymers toward efficient use of less utilized carbon resources.

1. Degradation of thermosetting resins[1]

Catalytic degradation of thermosetting resins, specifically epoxy resins, polyurethanes, and polyureas will be presented. By employing strategies that enable selective and efficient bond cleavage, we have successfully recovered valuable monomeric components in good yields, thereby demonstrating a potential route toward circular material use for these otherwise difficult-to-recycle materials.



2. Design and synthesis of degradable olefin-based materials[2]

The design and synthesis of degradable olefin-polymers will be presented offering new possibilities for materials with built-in end-of-life solutions. Introduction of side-chain carboxylic acid groups and in-chain ketone groups will be discussed.

3. Carbon dioxide as a monomer for polymer synthesis[3]

If time permits, we will also touch upon our preliminary results in the development of novel polymers derived from carbon dioxide, highlighting its potential as a sustainable C1 building block in polymer chemistry.

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