Bioethanol production from woody biomass using microwave technology

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There is growing demand to develop new, highly efficient technology to produce bioethanol and chemicals from woody biomass. For enzymatic conversion of lignocellulosics, pretreatments to expose cell wall polysaccharides is necessary. Efficient conversion of the enzymatic hydrolyzates by ethanologenic microbes are also the key factor for bioethanol production. In our NEDO project (R&D member: RISH, Kyoto Univ., Prof. Hideshi Yanase, Fac. Eng. Tottori Univ., Japan Chemical Engineering & Machinery Co. Ltd., and Toyota Motor Corporation), we have applied microwave-assisted solvolysis to the pretreatment. We have developed microwave solvolysis system with various catalysts and new continuous microwave reactors by applying 3D electromagnetic simulation technique[1-6]. Through cell-surface engineering based on genome DNA analysis, novel, high-performance ethanologenic bacteria, *Zymobacter palmae* and *Zymomonas mobilis,* which efficiently convert hexoses and pentoses to bioethanol, secrete β-glucosidase, and display cellulase on the surface of the cells, are being bred in Tottori Univ. A high-performance fermentation process using the ethanologenic bacteria is being developed to produce bioethanol from fast growing wood. A bench scale plant for bioethanol production using the pretreatment system and genetically engineered bacteria was build in 2010 (Fig. 1), and bioethanol was produced in a 300 L-scale jar fermentor. Production of value-added aromatic chemicals from lignin is indispensable to replace oil refinery to biorefinery. Therefore, we have been studying conversion of lignin to functional polymers and low molecular mass aromatics by microwave reactions. We also investigate detailed structures of pretreated lignocellulosics and their components by ultra-high sensitivity NMR, ultra-high resolution mass spectroscopy and fluorescent-labeled carbohydrate binding modules (CBM), aiming at maximizing conversion efficiency with minimum enzyme dosage and energy[7,8].

Fig. 1 Bench scale plant for bioethanol production from woody biomass (NEDO project).

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