Recently, much attention has been focused on utilization of natural gas (methane) as a feedstock for green chemistry. Methanol which is produced from methane is also a useful industrial raw material because it is low in cost and easy to transport. Together with fossil fuels and biomass, methane and methanol are major natural carbon resources we can utilize in the future. We are investigating how the microbes utilize these natural resources from the aspect of biochemistry, molecular biology, and intracellular dynamics. Based on the cellular functions of these microbes, we are conducting studies in new biotechnology for production of useful compounds.

We are looking for novel cellular functions of microbes which utilize natural carbon resources (fossil fuels, natural gas and biomass) and applying them to biotechnology.

We are aiming at elucidation of metabolic function and regulatory mechanism of gene expression in microbes which utilize methanol or a variety of alkanes. We have developed a high-level heterologous gene expression system in methanol-utilizing yeasts and have produced useful proteins successfully.

In methanol-utilizing yeasts, peroxisomes (P) are proliferated up to 80% of total cell volume (left). We could produce useful proteins within peroxisomes at a high level (right).

We have developed methods for visualization of the membrane dynamics and oxidative stress level within living yeast cells. Using these methods, we are aiming at elucidation of the molecular mechanism of protein sorting to peroxisomes and degradation of peroxisomes (pexophagy).
Keywords

Natural resources, natural gas, biomass, molecular circulation, molecular and cellular biology, heterologous gene expression, protein degradation, lipid and membrane dynamics, oxidative stress, redox, C1 microbes, methane, methanol

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