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Introduction to Session 4: Microbial Interactions with Coal

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Coal is one of our major energy sources and direct utilization of coal results in severe environmental pollution problems such as release of sulfur and nitrogen oxides into atmosphere. Coal can also be used as a chemical feedstock to substitute oil. A large variety of chemicals can be derived from complex aromatic structure of coal. Therefore, coal cleaning (desulfurization, denitrogenation, ash removal) and coal processing (gasification, liquefaction, depolymerization) are given considerable attention in recent years. Biological processing (microbial and enzymatic) of coal has distinct advantages over chemical processes operating at high temperature and pressures. Bioprocesses provide very specific conversions and operate under mild conditions (25°C–50°C and atmospheric pressure), resulting in low capital and operating costs. Moreover, regeneration of oxidants/reductants is not a problem since microbial (not enzymatic though) processes are autocatalytic.

A large number of coal conversion reactions can be catalyzed by biological systems. Coal desulfurization, denitrogenation, liquefaction and flue gas desulfurization/denitrogenation by biocatalysis have been achieved. However, biological processing of coal is at its infancy. Basic microbiology and enzymology of the aforementioned conversions are not known. Considering complex and highly variable structure of coal, it is quite obvious that research efforts need to start with some model compounds present in coal, to provide a better understanding of coal bioconversions. Isolation and development of new organisms for coal bioprocessing and elucidation of the enzymology of these conversions are major tasks to be accomplished in the near future.

This has been the first session held on coal bioprocessing in this Biotechnology Symposium series. The emphasis in this session is on coal

desulfurization (pyritic and organic sulfur removal) coal solubilization (oxidation by microbial and enzymatic catalysis) and alcohol formation via indirect liquefaction. We hope the effort in bioprocessing of coal will intensify in coming years to enable us to arrange further sessions on coal bioprocessing.