H_2/CO-O_2/H_2O_2 Molecular Fuel Cells

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H_2-O_2 fuel cells are one of the promising devices for energy conversion. However, important issues in fuel cells are poisoning of platinum catalysts by small amount of CO, which is contained in commercial supplies of H_2 at the anode, and damage of non-Pt catalysts and membranes by H_2O_2, which is produced by incomplete reduction of O_2 at the cathode. In order to address these problems, much researches have focused on catalysts that can function in their presence or even utilize them as part of the feed stream. Although some kind of fuel cells system have been reported, molecular fuel cell systems, which are based on molecular catalysts, are attractive approach due to highly variable design of molecular catalysts and elucidation of the details of the reaction mechanism. Therefore, appropriate design of molecular catalysts enables us to utilize H_2 and CO as anode fuels, and O_2 and H_2O_2 as cathode gases.

Oxidations of H_2 and CO in biological systems are catalyzed by [NiFe]hydrogenase ([NiFe]H_2ase) and CO dehydrogenase (CODH), respectively. Furthermore, O_2-tolerant [NiFe]H_2ase catalyzes the reduction of O_2 and decomposition of H_2O_2. Here, we report a NiIr catalyst as models for both [NiFe]H_2ase and CODH, which can catalyze simultaneous oxidations of both H_2 and CO, and a NiRu catalyst as a model for O_2-tolerant [NiFe]H_2ase, which is capable of catalyzing simultaneous reductions of both O_2 and H_2O_2 (Figure 1)[1,2]. Furthermore, we have reported the first successful construction of fuel cells running on H_2/CO and O_2/H_2O_2 by employing these two multifunctional catalysts. [1,2]

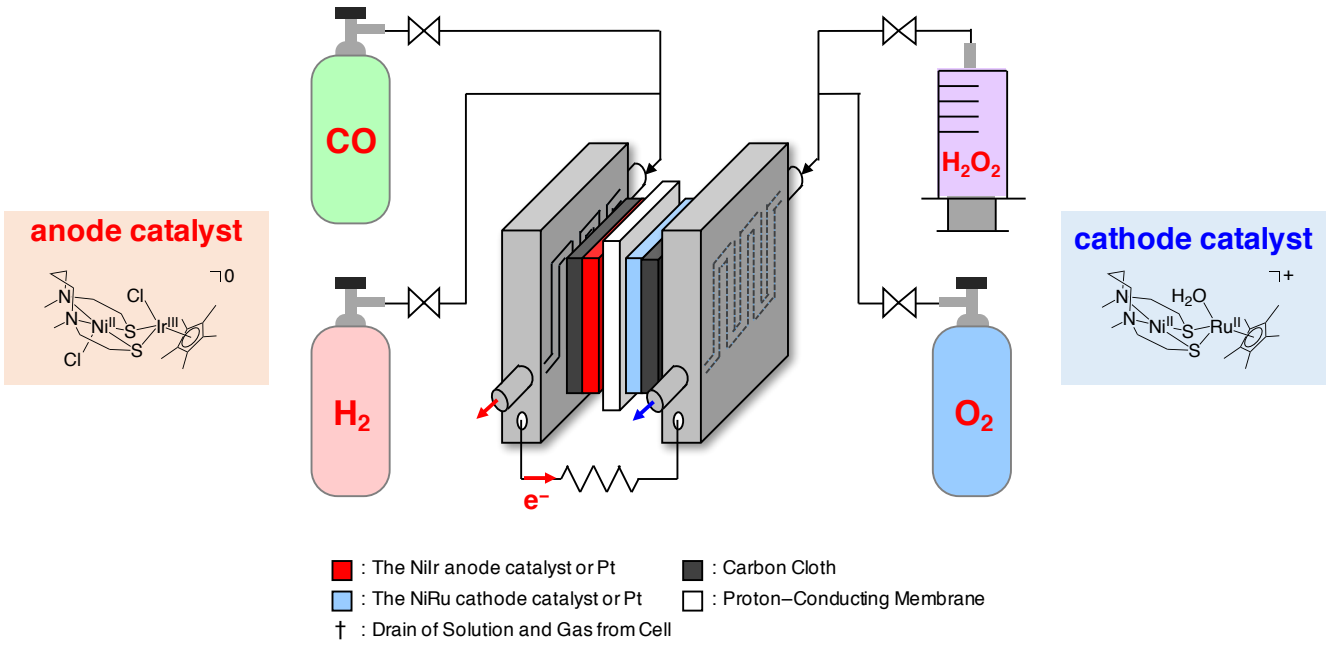

Figure 1. H_2/CO-O_2/H_2O_2 molecular fuel cells fabricated with multifunctional NiIr and NiRu catalysts.

References

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