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Reduction of low concentration of CO_2 using metal-complex catalysts

Osamu Ishitani*
Department of Chemistry, Tokyo Institute of Technology, Tokyo 152-8551, Japan
*Corresponding author: ishitani@chem.titech.ac.jp

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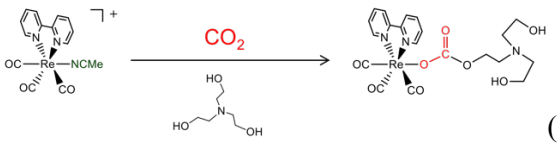
We have to develop artificial systems which can convert CO_2 to useful and energy-rich compounds by using renewable energy especially solar energy because the human beings have produced a huge amount of CO_2 mainly from fossil resources for making energy. Exhaust gases from such as thermal power plants and iron manufactures contained several % - 20% of CO_2. Although several methods such as adsorption and desorption methods using amines and membrane filtration have been already developed for enrichment of CO_2, these procedures require high energy consumption. If low concentration of CO_2 can be directly reduced by artificial methods, it should give a new direction of researches for artificial photosynthesis.

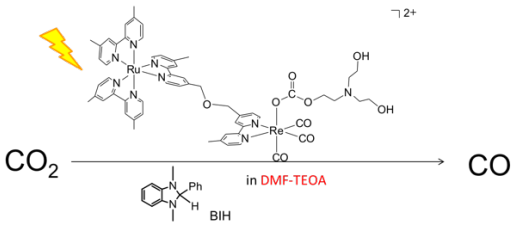
In this presentation, I report such systems using CO_2-capturing properties of metal complexes. It has been reported that *fac*-$[Re^{I}(diimine)(CO)_3X]^{n+}$ can work as both photocatalyst and electrocatalysts for CO_2 reduction. We found that the Re complexes also have CO_2-capturing properties with the assistance of triethanolamine (TEOA) as shown in the eq.1. Although this reaction is in equilibrium, the equilibrium constant is very large ($K = 1.7 \times 10^3\ M^{-1}$). This means that the Re complex can efficiently capture CO_2 from gases containing low concentration of CO_2 such as 1% CO_2.



(1)

This type of CO_2 adducts work as a catalyst for both photochemical and electrochemical reduction of CO_2.

A Ru(II)-Re(I) binuclear complex consisting of a $[Ru(diimine)_3]^{2+}$ type photosensitizer unit and the Re complex as a catalyst unit, so-called supramolecular photocatalyst, efficiently photocatalyzed reduction of low concentration of CO_2 (even 1% CO_2) as shown in eq. 2.[2]



(2)

Electrocatalytic reduction of low concentration of CO_2 also proceeded by using a Re mononuclear complex with the deprotonated TEOA as a ligand.

References

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