Enhanced Bimetallic CoM-ZIF/CdS for Effective Photocatalytic Hydrogen Evolution

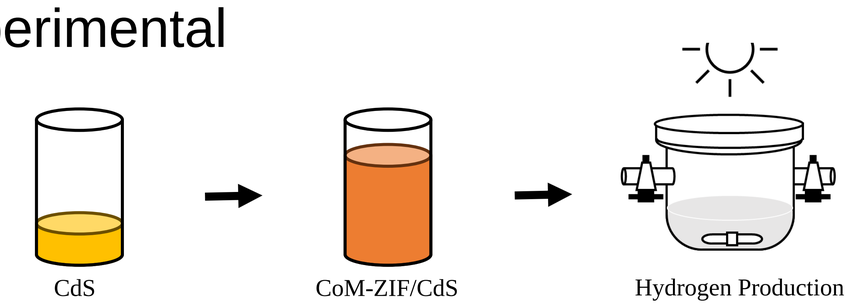
Chaehyun An, Sumin Yi, Yurim Lee

Department of Chemical Engineering, University of Seoul, Seoul, Korea

◎ Introduction

- **Photocatalyst** is required for the production of renewable hydrogen energy from solar energy since the need for eco-friendly energy is increasing due to global warming.
- **ZIF-67, zeolite imidazole framework using Co metal ions,** has a large surface area, low band gap, high thermal and chemical stability and photocatalytic activity in the visible light region.
- The purpose of this study is 1) synthesizing CoM-ZIF/CdS photocatalyst by heterojunction of CdS and transition metals such as Ni, Zn, Cu, and Sn to ZIF-67 and 2) measuring hydrogen production of each photocatalyst by using Gas Chromatography.

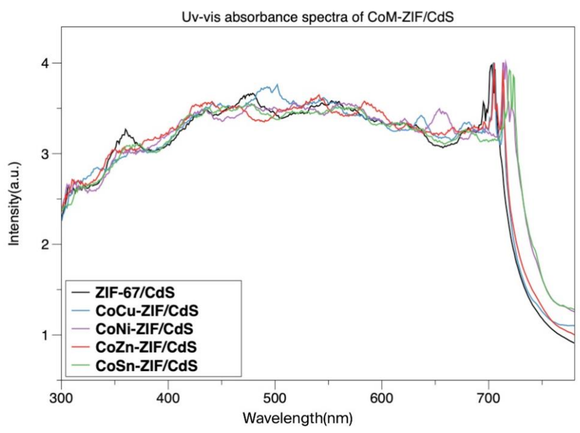
◎ Experimental



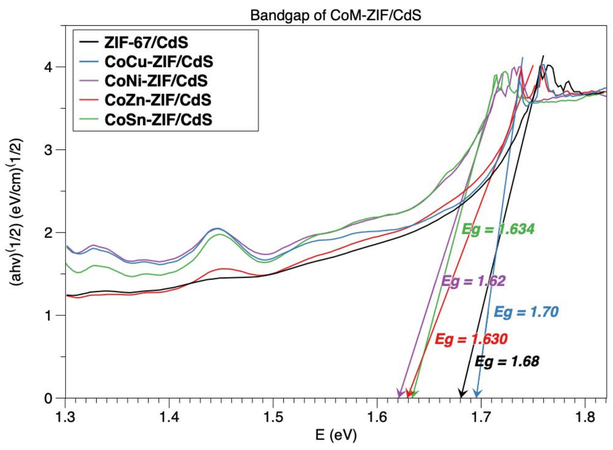
1) CdS is synthesized from the reaction of Cd(NO3)2·6H2O and Na2S·9H2O
2) CoM-ZIF/CdS(M=Zn, Ni, Cu, Sn) is synthesized by heterojunction of CdS and CoM-ZIF from the reaction of PVP, Co(NO3)2·6H2O, metal nitrate reagent, 2-methylimidazole.
3) Hydrogen production is measured by Gas Chromatography and further analysis such as surface observation, visible light absorbance, and band gap is conducted by SEM, Uv-vis spectroscopy.

◎ Results and Discussion

- Absorbance at wavelength from 300 nm to 800 nm (visible light region)

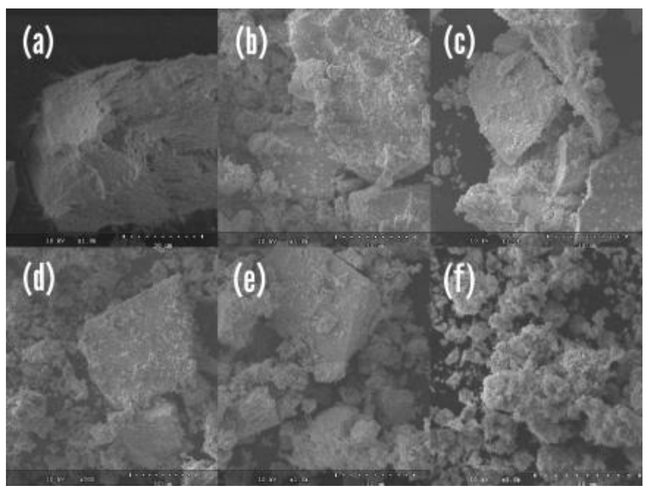


- Band gap analysis by using Tauc plot



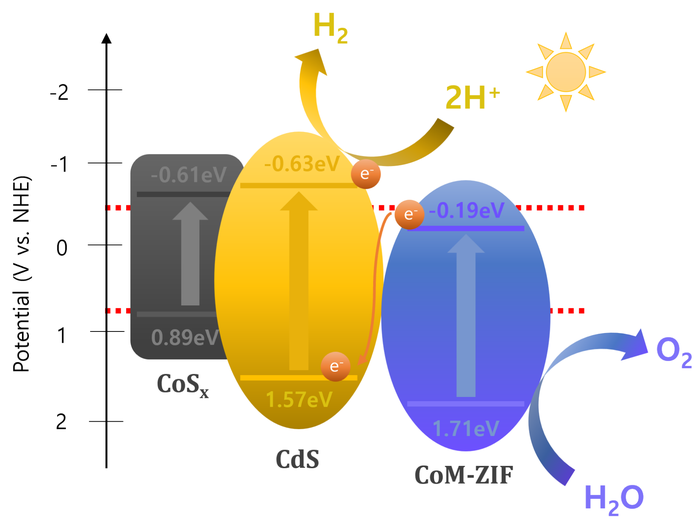
	ZIF-67/CdS	CoNi-ZIF/CdS	CoCu-ZIF/CdS	CoZn-ZIF/CdS	CoSn-ZIF/CdS
Band gap [eV]	1.68	1.62	1.70	1.630	1.634

- SEM images of ZIF-67, ZIF-67/CdS and CoM-ZIF/CdS (M = Cu, Ni, Zn, Sn)

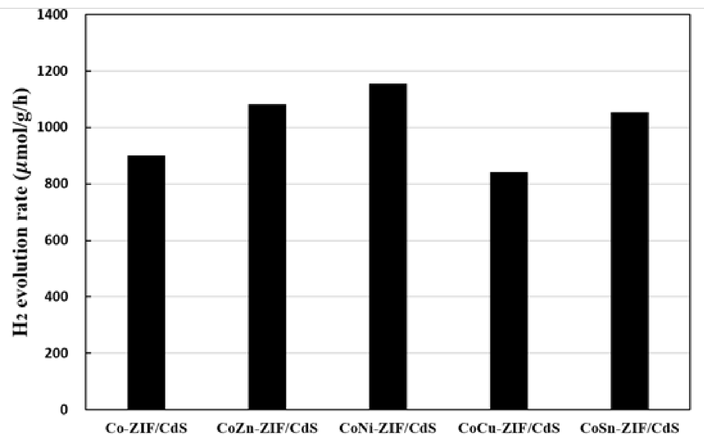


(a) ZIF-67
(b) ZIF-67/CdS
(c) CoCu-ZIF/CdS
(d) CoNi-ZIF/CdS
(e) CoZn-ZIF/CdS
(f) CoSn-ZIF/CdS

- Scheme diagram of CoM-ZIF/CdS with by-product, CoS

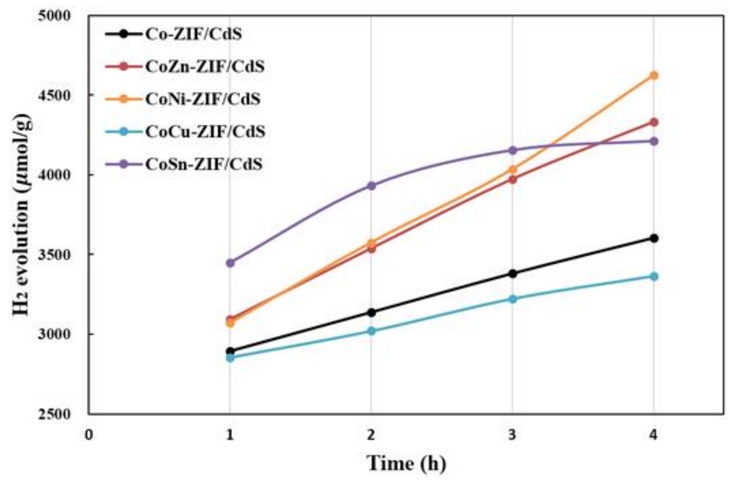


- Average hydrogen evolution rate



	μmol/g/h
Co-ZIF/CdS	900.94
CoZn-ZIF/CdS	1083.21
CoNi-ZIF/CdS	1156.46
CoCu-ZIF/CdS	841.27
CoSn-ZIF/CdS	1053.57

- Hydrogen production of each photocatalyst over time



◎ Conclusions

1) ZIF-67/CdS showed better hydrogen production performance than ZIF-67 through heterojunction with CdS.
2) CoM-ZIF/CdS showed better hydrogen production performance than ZIF-67/CdS by heterojunction with M = Ni, Zn, Sn.
3) CoNi-ZIF/CdS photocatalyst showed the highest hydrogen production because of the high absorbance in visible region with the narrowest band gap.