Electrochemical reduction of CO_2 to synthesis gas on CNT supported $Cu_xZn_{1-x}O$ catalysts

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Abstract: Electrochemical CO_2 reduction is a promising method for the production of CO_2 neutral fuels and chemicals from renewable electricity. ZnO supported on CNT is a low-cost electro catalyst that can produce syngas from CO_2 and H_2O. A rational catalyst design strategy for further improvement of the ZnO/CNT catalyst is to dope with copper to strengthen the binding energy of the CO intermediate, which could improve the activity. In this work, a series of CuZnO/CNT catalysts with intimate Cu and Zn contact and various Cu loadings are prepared. By varying the copper content we show that the synergy of copper and zinc improves the activity for CO formation, and the optimal copper content is 20 at%. On hydrogen evolution, the addition of copper has a two-fold effect. This reaction is enhanced by the reduced ZnO particle size obtained when copper is added, but at similar particle sizes of ZnO, a suppression is observed with increasing copper content as CO evolution is enhanced. Stability tests showed that pure ZnO phase is more stable than metallic copper on ZnO. Compared with polycrystalline silver, the CuZnO/CNT catalysts are more active for syngas formation at a useful CO: H_2 composition. This work demonstrates that the viability of DFT based rational design of electrochemical CO_2 reduction catalyst. By varying CuZnO composition as well as crystallite size, one is able to tune the electrochemical reduction activity towards CO and H_2, and therefore achieve desired syngas ratio.
Key words: Electrochemical CO_2 reduction, Hydrogen evolution, Catalysis, Carbon nanotubes, Copper, Zinc

References

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