Copper-functionalized organic semiconductor for electrocatalytic CO_2 reduction

Xiaojiao Yuan, Katherine Villa
Institute of Chemical Research of Catalonia (ICIQ), Av. Països Catalans, 16, Tarragona 43007, Spain
E-mail: xyuan@iciq.es

Abstract

Organic Semiconductors are attracting increasing attention owing to their delocalized conjugated system and outstanding electrochemical property, electrical conductivity, and high carrier mobility.[1] In particular, the semiconductor redox potentials of CPs can be precisely modified through design of molecular structure such as donor-acceptor junctions. Recently, conjugated polymers have been studied as (photo)electrocatalysts for HER, OER. However, the performance of CPs for CO_2 reduction has been rarely investigated due to the complexity of the reaction that undergoes multi-electron and multi-proton pathways. Herein, we synthesize a copper-functionalized conjugated trimer with donor-acceptor-donor molecular structures by electrodeposition. With the synergistic effect between Cu and conjugated trimer, the composites can selectively reduce CO_2 to ethylene with a high Faradaic efficiency (max. 55% at −1.6 V) in broad potential windows and large current density (60 mA cm^{-2}). It is thus desirable to develop a family of heterogeneous catalyst with molecularly regulating electrocatalytic activity. The variation of activity in small molecules are strongly correlating with their physical properties such as energy band levels, and lifetime of excited particles. The results indicate that conjugated small molecules are promising applications in electrocatalytic chemical energy conversion.

References

[1] [1] Dr. Rong Wang, Xinyue Wang, Weijun Weng, Ying Yao, Dr. Pinit Kidkhunthod, Prof. Dr. Changchun Wang, Prof. Dr. Yang Hou, Prof. Dr. Jia Guo. Angewandte Chemie International Edition, 61 (2022), e202115503.

Figures

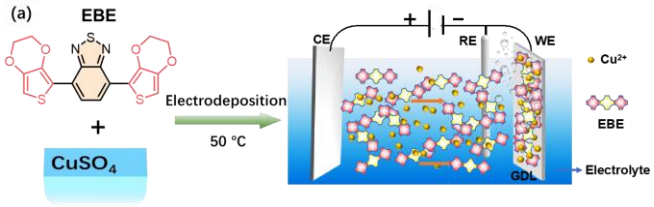

Figure 1: Experimental process for synthesis of Cu-EBE by electrodeposition.