Heterostructuring of Delafossite Photocathodes with Cu_2O for Efficient CO_2 Conversion

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Because of the global energy and environmental crisis caused by fossil fuels, interest in clean and renewable energy sources is increasing. Lately, conversion of CO_2 into fuel has received much of attraction to solve problems at a time. Especially, photo-electrochemical system could be the most promising candidate since it costs the least of electrical energy to convert CO_2 into fuel with aid of sunlight.

Herein, $CuCrO_2$(CCO) delafossite material has been studied as a CO_2 reduction photocathode. It was observed that the photoactivity of CCO was not that good (I_{max}=0.2 mA/cm^2) due to their large bandgap(E_g=3.2 eV). Fortunately, it was revealed from impedance spectroscopy that CCO has high majority carrier density and favorable band position for the formation of type-II heterojunction between Cu_2O(E_g=2.0 eV). Based on the analyses, CCO/Cu2O heterostructure was investigated. The heterostructure photocathodes showed enhanced photocurrent density as much as 9 times while suffered from severe photocorrosion of Cu_2O. Therefore, passivation layer treatment has been under investigation to enhnace the poor stabiity.