# Kinetic Analysis of Efficient Water Oxidation by Layer-by-Layer Assembled Catalytic Multilayers

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Solar water oxidation is a promising technology as a solution to global energy and environmental problems. Despite huge efforts devoted for several decades, it has remained challenging due to the limitations of photoanode candidates such as the high recombination rate and slow water oxidation kinetics. To address such problems, we recently developed a simple method to prepare highly efficient water-oxidation photoanode (PA) by modifying the surface of PA with layer-by-layer (LbL) assembled catalytic multilayers (CMs). We found that the photocatalytic activity of various PAs can be significantly improved after the deposition of the CMs. To elucidate its underlying mechanism, in this study, we carried out kinetic analysis using electrochemical impedance spectroscopy (EIS). Our analysis revealed that the deposition of CMs leads to the suppression of the exciton recombination and improvement of catalytic activity. As a result, PAs modified by CMs exhibited much higher performance than those with well-known water oxidation catalysts. We believe that the present study can provide theoretical framework for the design and application of electrochemical and photoelectrochemical devices.