Monitoring Charge Transfer Dynamics of Trapped Holes in ZnO Utilized for Ethanol Oxidation Using Near-Field Heterodyne Transient Grating and Charge Carrier-Selective Heterodyne Transient Grating Methods

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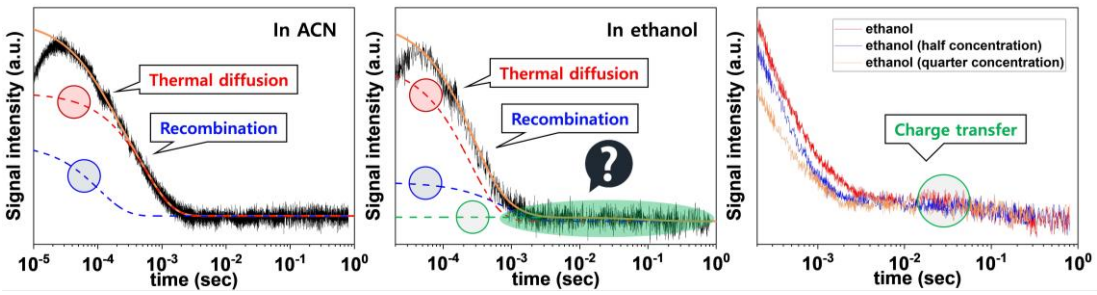
Zinc Oxide (ZnO) is actively researched as a photocatalyst.[1] Photocatalysis of ZnO can be initiated by the charge transfer of long-lived charge carriers on its surface.[2] However, the detection of these carriers is challenging due to their small quantities. To monitor these photo-induced charge carriers, we applied the near-field heterodyne transient grating (NF-HD-TG) method, known for its capability to sensitively observe physical and chemical phenomena at the liquid/solid interface.[3] In this study, we measured the NF-HD-TG responses of the ZnO film and observed three components: one attributed to thermal diffusion, another to the recombination of trapped electrons, along with an additional component. To understand the additional component, we measured NF-HD-TG responses at different ethanol concentrations, confirming its association with the transfer of trapped holes in ZnO to ethanol. Furthermore, we determined the energetic position of the surface trap state employing the charge-carrier selective transient grating (CS-HD-TG) method,[4] revealing that the state lies between 0.6 eV and 1.1 eV. This position is appropriately below the oxidation potential of ethanol as suggested by the previous research.[5]



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