Electrochemical reduction of CO_2 with hydride doped barium titanate.

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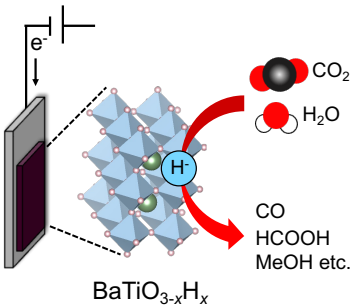
Oxyhydrides, in which oxide and hydride ions coexist in the same compound, are a new group of compounds that have been developed recently.[1] A typical perovskite oxyhydride $BaTiO_{3-x}H_x$ contains hydrides in its crystal, but is chemically stable under atmospheric pressure. This material is known to be active as a thermal catalyst for NH_3 synthesis and CO_2 reduction, and has attracted attention as a novel catalytic material.[2,3] The catalytic properties are attributed to sufficient diffusivity and anion exchange properties of the hydride ions stabilized in oxide frameworks. While this material is also promising as an electrochemical device for chemical/energy conversion due to its metallic conduction, it has never been evaluated as an electrocatalyst for CO_2 reduction. Our research group has discoverd that $BaTiO_{3-x}H_x$ could be a promising new electrocatalyst for the production of alcohols from CO_2. In this study, we investigated in detail the effect of hydride in $BaTiO_{3-x}H_x$ crystals on the CO_2 reduction activity.

$BaTiO_{3-x}H_x$ with different hydride contents x were synthesized by changing the raw material ratios of the precursor oxide and calcium hydride, and the x-dependence of the activity was investigated. When CO_2 reduction was conducted in acetonitrile, the product distribution changed with respect to the hydride content, indicating that the hydride in the crystal may contribute to the selectivity. There was also a trend toward an increase in the number of multi-electron reduced species with hydride content. A series of control experiments indicated that the reduction reaction proceeds electrochemically and that hydride does not simply react as a reducing agent. XAFS and XPS measurements indicated that surface hydrides may be involved in the catalytic reaction.



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