

Discovery of highly reduced oxide SrCoO₂ via electrochemical proton reduction and dehydration

Hao-Bo Li^a, Shunsuke Kobayashi^b, Chengchao Zhong^a, Morito Namba^a, Yu Cao^a, Daichi Kato¹, Yoshinori Kotani^c, Qianmei Lin^a, Maokun Wu^d, Wei-Hua Wang^d, Masaki Kobayashi^e, Koji Fujita^e, Cédric Tassel^a, Takahito Terashima^f, Akihide Kuwabara^b, Yoji Kobayashi^a, Hiroshi Takatsu^{a,*}, Hiroshi Kageyama^{a,*}

a: Department of Energy and Hydrocarbon Chemistry, Graduate School of Engineering Kyoto University, Kyoto, 615-8510 Japan.

b: Nanostructures Research Laboratory, Japan Fine Ceramics Center, Nagoya, 456-8587 Japan.

c: Japan Synchrotron Radiation Research Institute, 1-1-1, Kouto, Sayo-cho, Sayo-gun, Hyogo, 679-5198 Japan.

d: Department of Electronic Science and Engineering, and Tianjin Key Laboratory of Photo-Electronic Thin Film Device and Technology, Nankai University, Tianjin 300071 China.

e: Department of Material Chemistry, Graduate School of Engineering, Kyoto University, Katsura Nishikyo-ku, Kyoto 615-8510, Japan.

f: Department of Physics, Graduate School of Science, Kyoto University, Kyoto 606-8502,

Corresponding author: kage@scl.kyoto-u.ac.jp takatsu@scl.kyoto-u.ac.jp

Controlling oxygen deficiencies is essential for the development of novel chemical and physical properties in strongly correlated oxides. Since 1999, low-temperature topochemical reactions using metal hydrides (e.g., CaH₂) are known as a powerful method to lead to highly reduced oxides such as SrFeO₂¹ and LaNiO₂², although their applicability is limited due to uncontrollable product. In this work, we have adopted the most common reaction, dehydration, to triggers a concealed reaction route towards an undiscovered reduced phase of SrCoO₂. Our strategy takes full advantage of the strong energy provided by electric-field to inject the proton into the perovskite oxides, which consequently forms O-H bonding and destabilizes the precursor. Though the electric-field controlled proton injection is reported in many oxides, however the dehydration reaction in the afterward is hardly investigated. Our results indicate that the electric-field injected H⁺ can ‘drag’ oxygen out of the lattice in form of H₂O during heating. This leads to a reduced phase that cannot be obtained by previous strategies such as topochemical reduction with metal hydride. This does not create a novel type of layered perovskite with four-legged spin tube, but also bring about another route to control the oxygen stoichiometry in strongly correlated oxides.

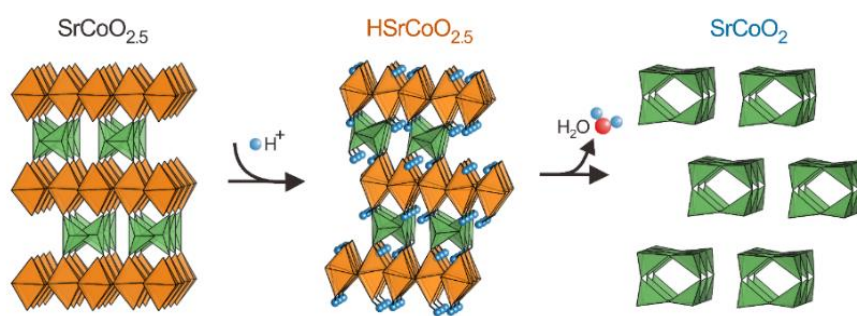


Figure 1. The structure evolution of electrochemical protonation and dehydration.

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