Control of metal-oxygen bond length boosts the redox ex-solution in a perovskite oxide surface

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Redox ex-solution, in-situ synthesis process of metal nanoparticles upon high-temperature reduction has widely been studied as a way to fabricate metal nanocatalyst-decorated oxide for energy conversion devices. However, the underlying mechanisms related to this phenomenon are not completely understood and practical solutions that effectively accelerate B-site cation ex-solutions in perovskite oxide (ABO_3) have not yet been proposed. Here, the degree of Co ex-solution at the surface of $SrTi_{0.75}Co_{0.25}O_{3-\delta}$ epitaxial thin films is controlled through the engineering of metal-oxygen bond length. Combined theoretical and experimental analyses show that the stretched Co-O bond can promote the Co ex-solution in $SrTi_{0.75}Co_{0.25}O_{3-\delta}$. Based on these findings, Co ex-solution can be remarkably promoted to improve the surface CO oxidation reactivity of $SrTi_{0.75}Co_{0.25}O_{3-\delta}$, when a large-sized isovalent dopant is added. This method to promote ex-solution can be readily applied to various heterogeneous catalysts.