

## Metal Nanoparticle Exsolution on Perovskite Oxide Support for Stable High Temperature Water Gas Shift Reaction

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We designed a stable and Cr-free catalyst for the high-temperature water gas shift reaction (HT-WGS). The perovskite particle has the formula of  $\text{La}_{0.9}\text{Fe}_{0.95}\text{Ni}_{0.05}\text{O}_3$  and has Ni metal nanoparticles (NPs) exsolved on its surface after reduction treatment (denoted as LFN-R). The LFN-R catalyst had higher catalytic activity as well as better long-term stability than commercial Fe-Cr and Ni-loaded Ni/LFO catalysts. XRD, SEM, HR-TEM and XPS analyses were used to confirm the existence of the exsolved Ni metal NPs. An experimental study of the thermal process revealed the improved CO adsorption ability of LFN-R and the importance of water as the oxygen source for WGS reaction. The role of LFN-R as the oxygen transmitter by water dissociation was confirmed by DFT calculations and DRIFT results. We believe that our results can increase the possibility of achieving a stable and economical catalyst for high temperature gas-phase reactions.