

NO impact on CO oxidation for Pt/Al₂O₃ and Pt/CeO₂

S. Struzek¹ and D. Gashnikova¹, F. Maurer¹, M. Casapu¹, J.-D. Grunwaldt^{1,2}

¹Institute for Chemical Technology and Polymer Chemistry (ITCP), Karlsruhe Institute of Technology (KIT), Engesserstraße 20, 76131 Karlsruhe, Germany

²Institute of Catalysis Research and Technology (IKFT), Karlsruhe Institute of Technology (KIT), Hermann-von-Helmholtz-Platz 1, 76344 Eggenstein-Leopoldshafen, Germany

E-Mail presenting author: samuel.struzek@kit.edu

Noble metals are known to exhibit a dynamic behavior in regard to their chemical state and particle size under transient reaction conditions^{1,2}. The influence of NO on the catalytic activity and the chemical platinum state for the CO oxidation reaction is still unclear. Hence, we aim to reveal the impact of NO on the sintering behavior and CO oxidation activity of Pt-based catalysts under close-to-stoichiometric conditions using complementary *in situ/operando* techniques³. To uncover the influence of the support material and of the initial Pt particle size, highly dispersed Pt/CeO₂ and particle-containing Pt/Al₂O₃ were used. The results of the catalytic testing revealed a shift of the CO conversion to higher temperatures for both catalysts in the presence of NO. Competitive adsorption of CO and NO on Pt, discovered by *in situ* DRIFTS and *operando* HERFD-XANES investigations, may be one of reasons for the observed trends in catalytic performance. According to spatially-resolved *operando* XAS investigations, Pt sintering was found to start downstream and progress upstream with increasing temperature. Under NO-containing conditions, Pt sintering was shifted to higher temperatures for Pt/Al₂O₃ and Pt/CeO₂. As a consequence, a more oxidized Pt state at the beginning position was obtained for highly dispersed Pt/CeO₂ after reaction. Highly dispersed Pt species are known to be less active for the CO oxidation reaction in comparison to Pt particles¹. The negative impact of NO on the formation of active Pt clusters can be overcome by applying a reductive treatment leading to a uniform larger particle size along the catalyst bed as confirmed by spatially-resolved *in situ/operando* XAS.

[1] Gänzler A. M., Casapu M., Vernoux P., Loridant S., Cadete Santos Aires F. J., Epicier T., Betz B., Hoyer R., Grunwaldt J.-D., *Angew. Chem., Int. Ed.*, 2017, 56, 13078–13082.

[2] Nagai Y., Hirabayashi T., Dohmae K., Takagi N., Minami T., Shinjoh H., Matsumoto S., *J. Catal.*, 2006, 242, 103–109.

[3] Sarma B. B., Grunwaldt J.-D., *Chimia*, 2024, 78.5, 288-296.