catalysts

MDPI

*Supplementary Materials*

# The Hydrothermal Stability and the Properties of Non- and Strongly-Interacting Rh Species over Rh/γ, θ-$Al_2O_3$ Catalysts

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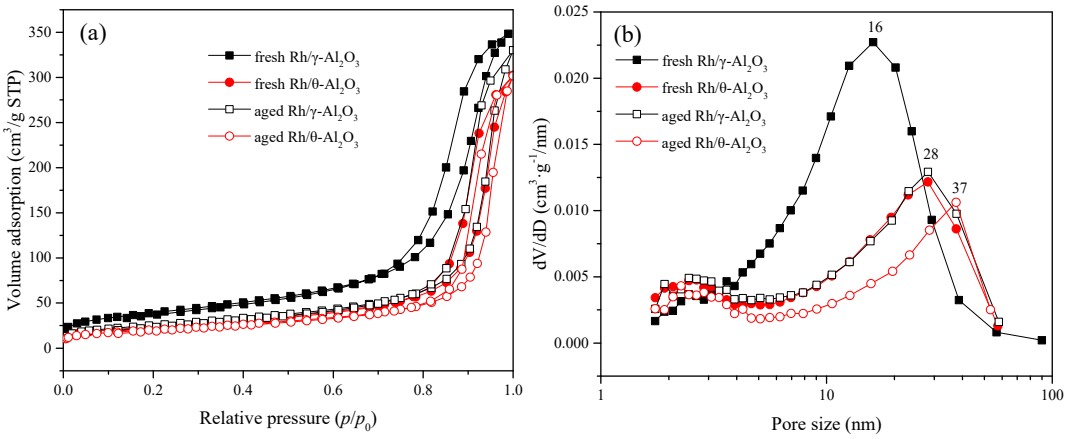


**Figure S1.** The $N_2$ physical adsorption and desorption analysis results for fresh and aged catalysts: (**a**) the isothermal plots and (**b**) pore size distributions.

**Table S1.** The physical properties of fresh and aged Rh/γ, θ-$Al_2O_3$ catalysts.

| Samples | BET ($m^2/g$) | | Pore volume ($cm^3/g$) | |
|---|---|---|---|---|
| | Fresh | Aged | Fresh | Aged |
| Rh/γ-$Al_2O_3$ | 139 | 91 | 0.54 | 0.48 |
| Rh/θ-$Al_2O_3$ | 83 | 72 | 0.47 | 0.44 |

**Table S2.** Quantification of Rh ($3d_{5/2}$) signals of Rh/γ, θ-$Al_2O_3$ catalysts.

| Samples | Binding energy of Rh $3d_{5/2}$ (eV) | | | $Rh^0$/Rh | $Rh^{3+}$/R | $Rh^{4+}$/Rh |
|---|---|---|---|---|---|---|
| | $Rh^0$ | $Rh^{3+}$ | $Rh^{4+}$ | (%) | (%) | (%) |
| fresh Rh/γ-$Al_2O_3$ | 307.4 | 309.4 | 310.4 | 11.9 | 56.4 | 31.7 |
| fresh Rh/θ-$Al_2O_3$ | 307.4 | 309.3 | 310.5 | 15.5 | 50.0 | 34.5 |
| deactivated Rh/γ-$Al_2O_3$ | - | - | 310.4 | 0 | 0 | 100 |
| deactivated Rh/θ-$Al_2O_3$ | - | - | 310.3 | 0 | 0 | 100 |

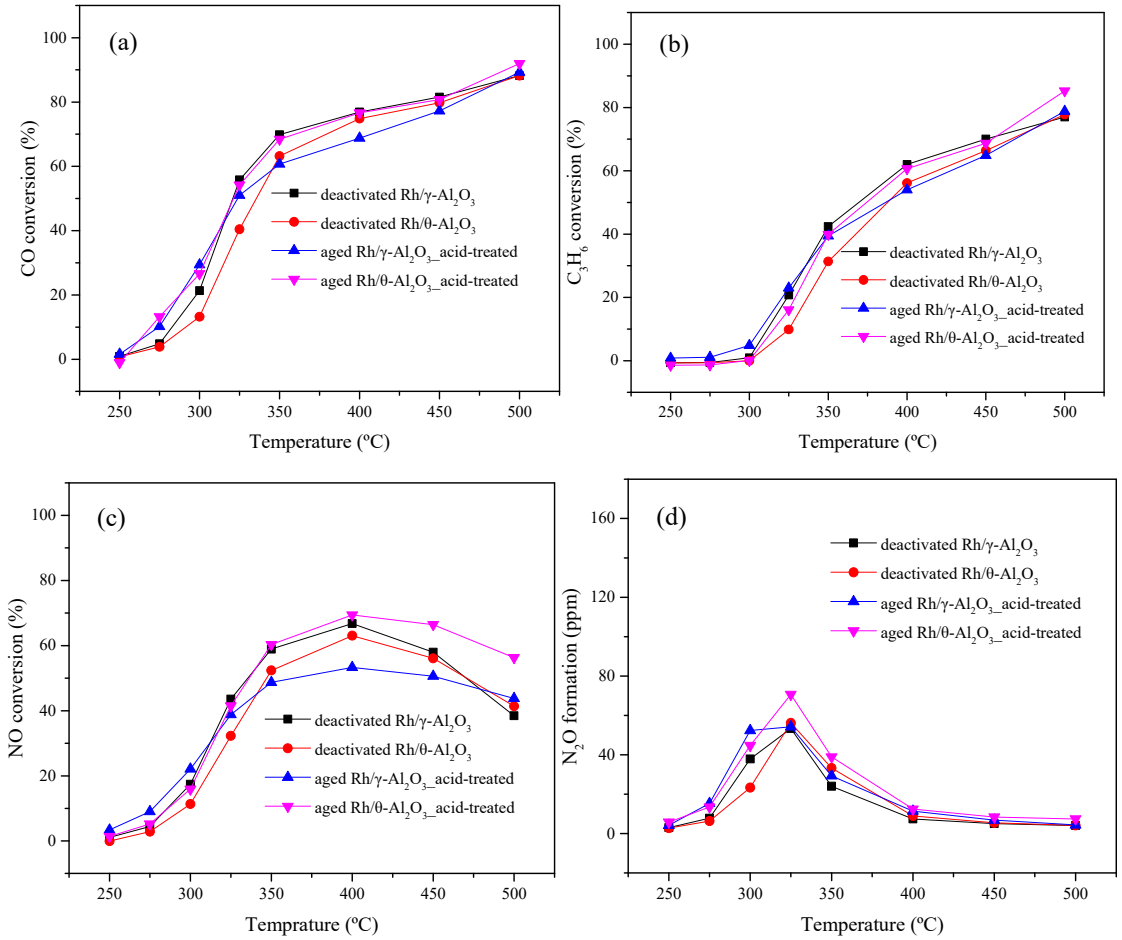


**Figure S2.** The profiles of (**a**) CO, (**b**) $C_3H_6$, (**c**) NO conversion, and (**d**) $N_2O$ formation over deactivated and aged Rh/γ, θ-$Al_2O_3$ after acid-treated (HCl-KBr) under TWC reaction condition. Feed stream: 1% CO, 1000 ppm HCs ($C_3H_6$:$C_3H_8$ = 2:1), 1000 ppm NO, 0.917% $O_2$, 12% $CO_2$, 3% $H_2O$, $N_2$ balance.

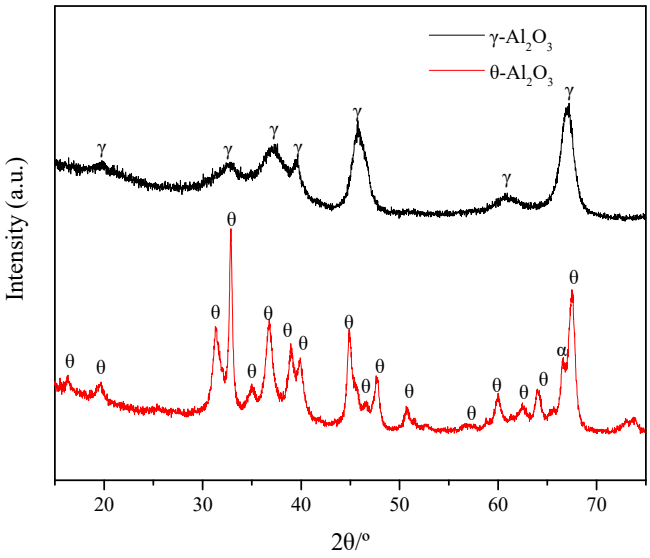


**Figure S3.** XRD patterns of catalyst supports.