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Enhancing the Proportion of Three-coordinated Al Active Sites on Co/Al_2O_3 for Efficient CF_4 Decomposition

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The Supporting Information includes 12 pages, 4 tables and 7 figures.

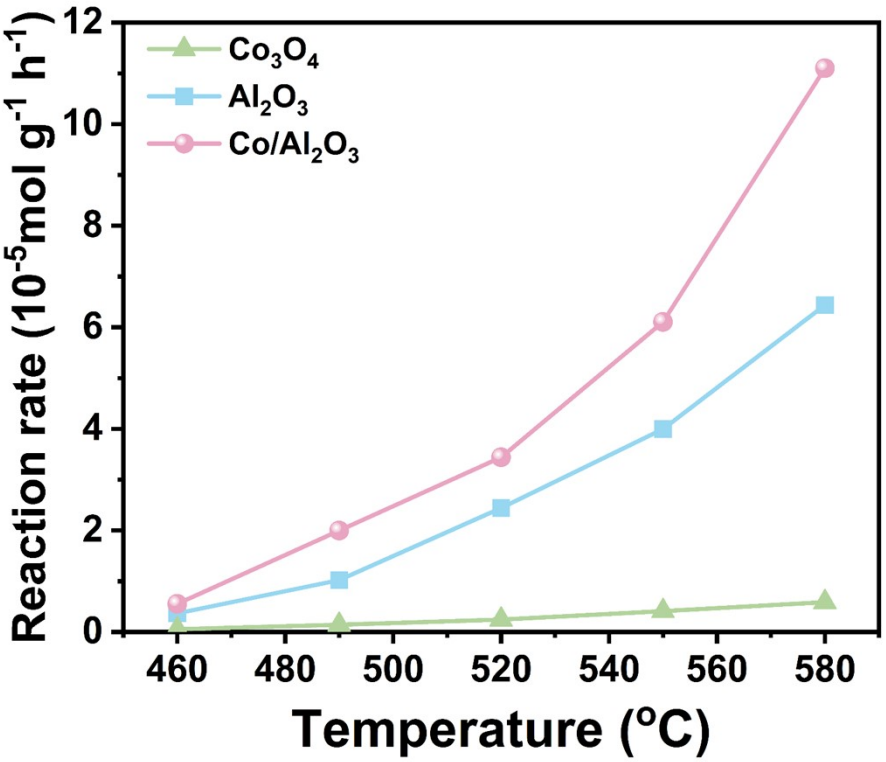

Fig. S1 Reaction rates of Co_3O_4, Al_2O_3 and $0.1Co/Al_2O_3$ catalysts at 460 - 580 °C

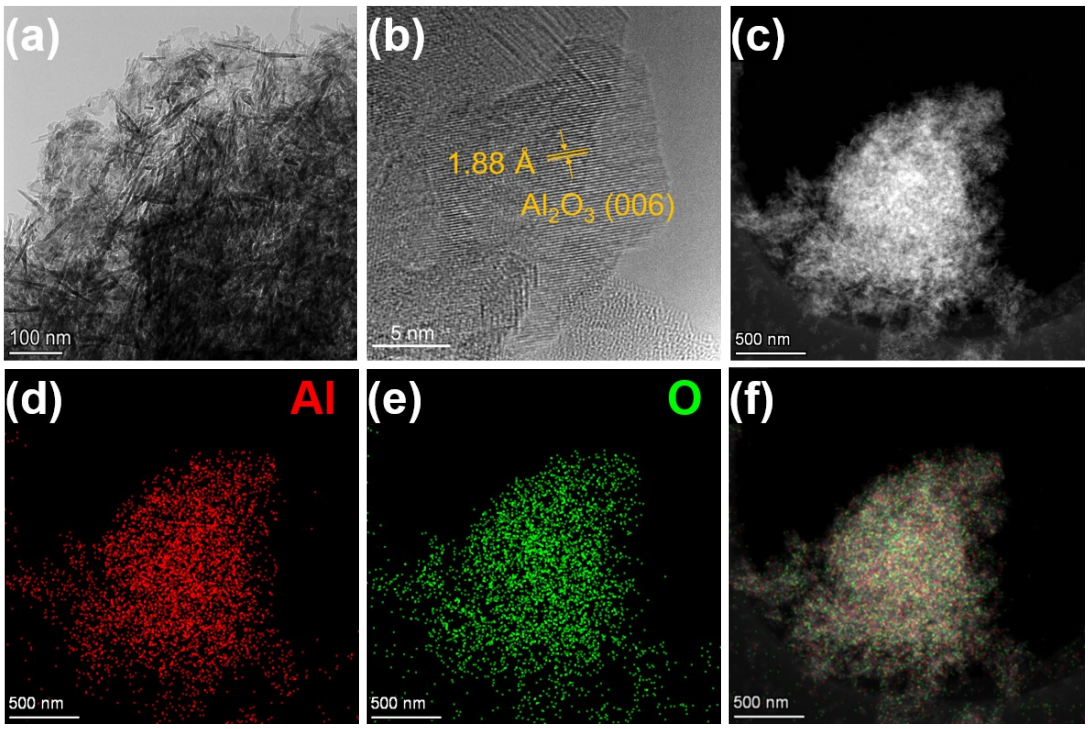

Fig. S2 TEM images and EDS mapping of Al_2O_3 catalyst.

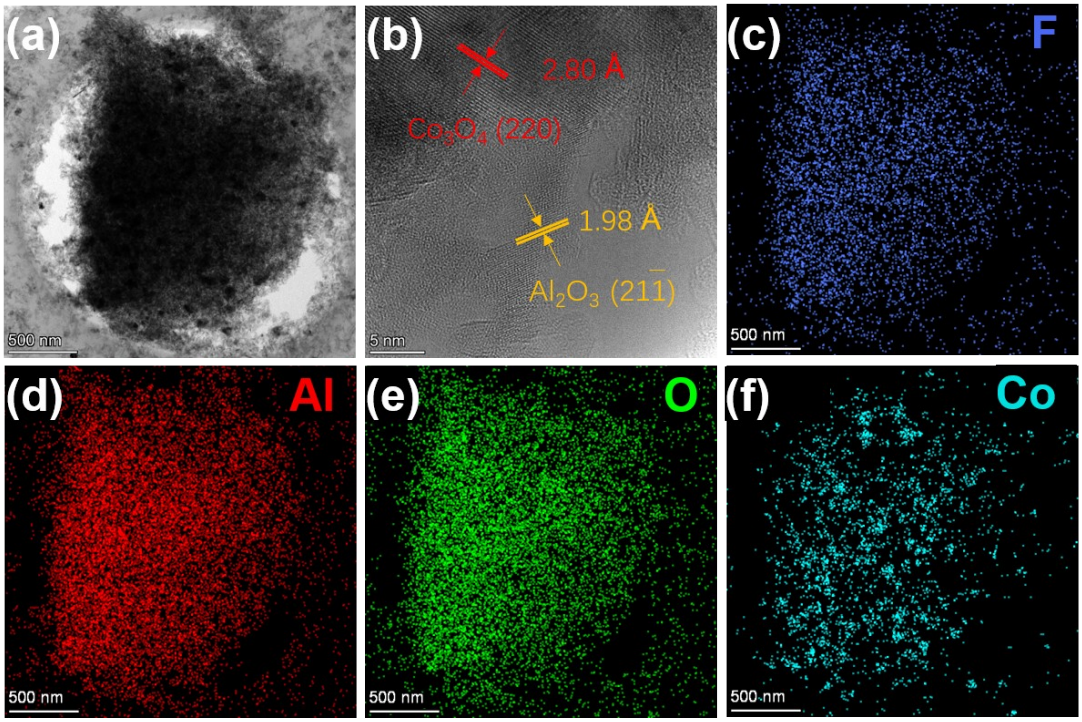

Fig. S3 TEM images and EDS mapping of 0.1Co/Al_2O_3-used catalyst.

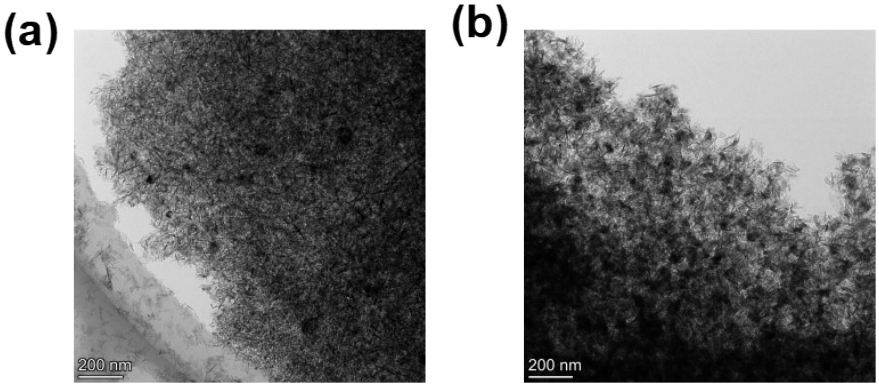

Fig. S4 TEM images of (a) $0.05/Al_2O_3$ and (b) $0.3Co/Al_2O_3$ catalysts.

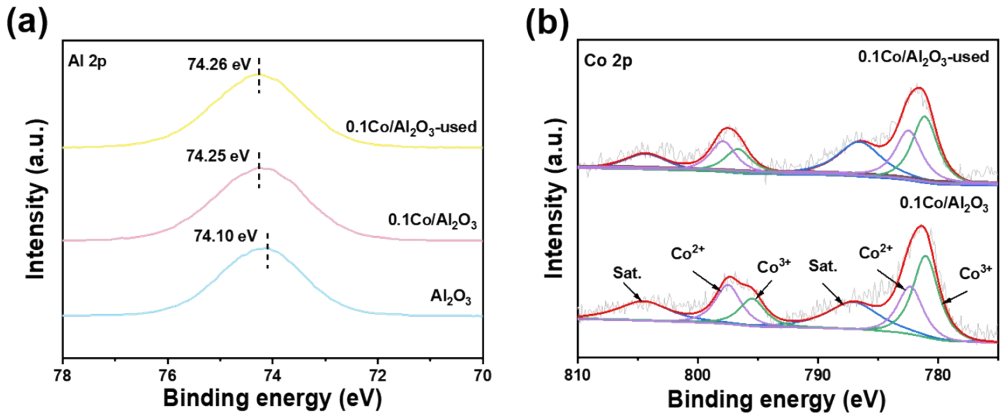

Fig. S5 (a) Al 2p and (b) Co 2p XPS spectra of Al_2O_3, 0.1Co/Al_2O_3 and 0.1Co/Al_2O_3-used.

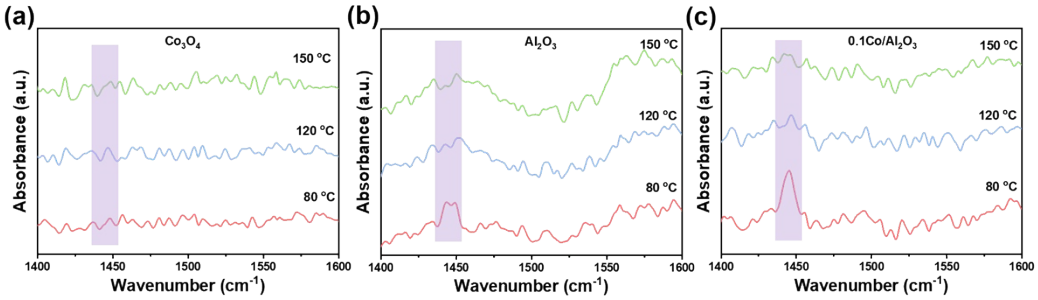

Fig. S6 Py-IR profiles of (a) Co_3O_4, (b) Al_2O_3 and (c) $0.1Co/Al_2O_3$ catalysts.

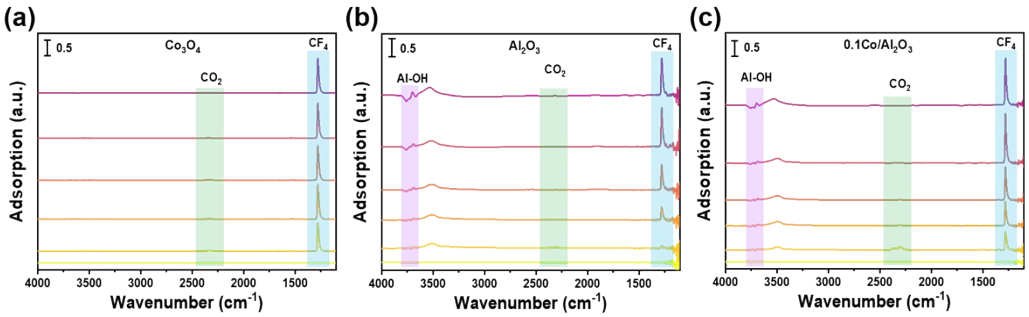

Fig. S7 *in situ* DRIFTS of CF_4 catalytic hydrolysis on (a) Co_3O_4, (b) Al_2O_3 and (c) $0.1Co/Al_2O_3$ catalysts.

Table S1. The comparison of CF_4 catalytic hydrolysis performance on the various Al_2O_3-based catalysts.

Catalysts	Reaction temperatures (°C)	CF_4 decomposition (%)	Long-term stability (h)	Ref.
Co/Al_2O_3	580	100	170	This work
$Zn\text{-}Al_2O_3$	560	100	250	*J. Am. Chem. Soc.* **2025**, 147, 7391-7399
$S\text{-}ZrO_2$	650	100	2	*Environ. Sci.: Nano* **2024**, 11, 881
$S\text{-}Al_2O_3@ZrO_2$	580	100	10	*Proc. Natl. Acad. Sci. U.S.A.* **2023**, 120, e2312480120
$Ga/\theta\text{-}Al_2O_3$	600	100	1000	*Angew. Chem. Int. Ed.* **2023**, 62, e202305651
$\gamma\text{-}Al_2O_3$	650	100	-	*Environ. Sci.: Nano*, **2022**, 9, 954
$S/Ce/\gamma\text{-}Al_2O_3$	650	50	45	*J. Mol. Catal. A-Chem.* **2013**, 370, 50
$AlPO_4/\gamma\text{-}Al_2O_3$	750	100	200	*Chem. Lett.* **2005**, 34, 364
$SO_4^{2-}/Ga/\gamma\text{-}Al_2O_3$	630	98	72	*Catal. Today* **2004**, *90*, 283
$Ga/\gamma\text{-}Al_2O_3$	680	95	20	*Appl. Catal. B-Environ.* **2003**, 40, 81
$Ce10\%\text{-}AlPO_4$	700	52	50	*Chem. lett*. **1999**, 28, 417

Table S2. The proportion of three-coordination Al of catalysts.

Samples	The proportion of three-coordination Al (%)
Al_2O_3	2
$0.1Co/Al_2O_3$	13

Table S3. The relative amount of CF_4 desorption of catalysts.

Samples	CF_4 adsorption
Co_3O_4	0
Al_2O_3	1
$0.1Co/Al_2O_3$	2

Table S4. The amount of acid sites by NH_3-TPD and Py-IR of Co_3O_4, Al_2O_3 and $0.1Co/Al_2O_3$ catalysts.

samples	Acidity(μmol·g^{-1})			
	weak acidity	medium acidity	strong acidity	total acidity
Co_3O_4	-	-	-	-
Al_2O_3	2.45	8.38	4.21	15.04
$0.1Co/Al_2O_3$	2.29	9.25	5.48	17.02

Determined by the normalized peak areas at 1443 cm^{-1} and 1540 cm^{-1} of the Py-IR spectra after desorption at 80 °C.