Supplementary materials

Enhancement of propane combustion activity over CoO_x catalysts by introducing C_2-C_5 diols

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Figure captions

Fig. S1. TG curves of different catalyst precursors.

Fig. S2. Reaction tail gas composition.

Fig. S3. Relationship between propane conversion and reaction temperature.

Table S1 Crystalline size of catalysts.

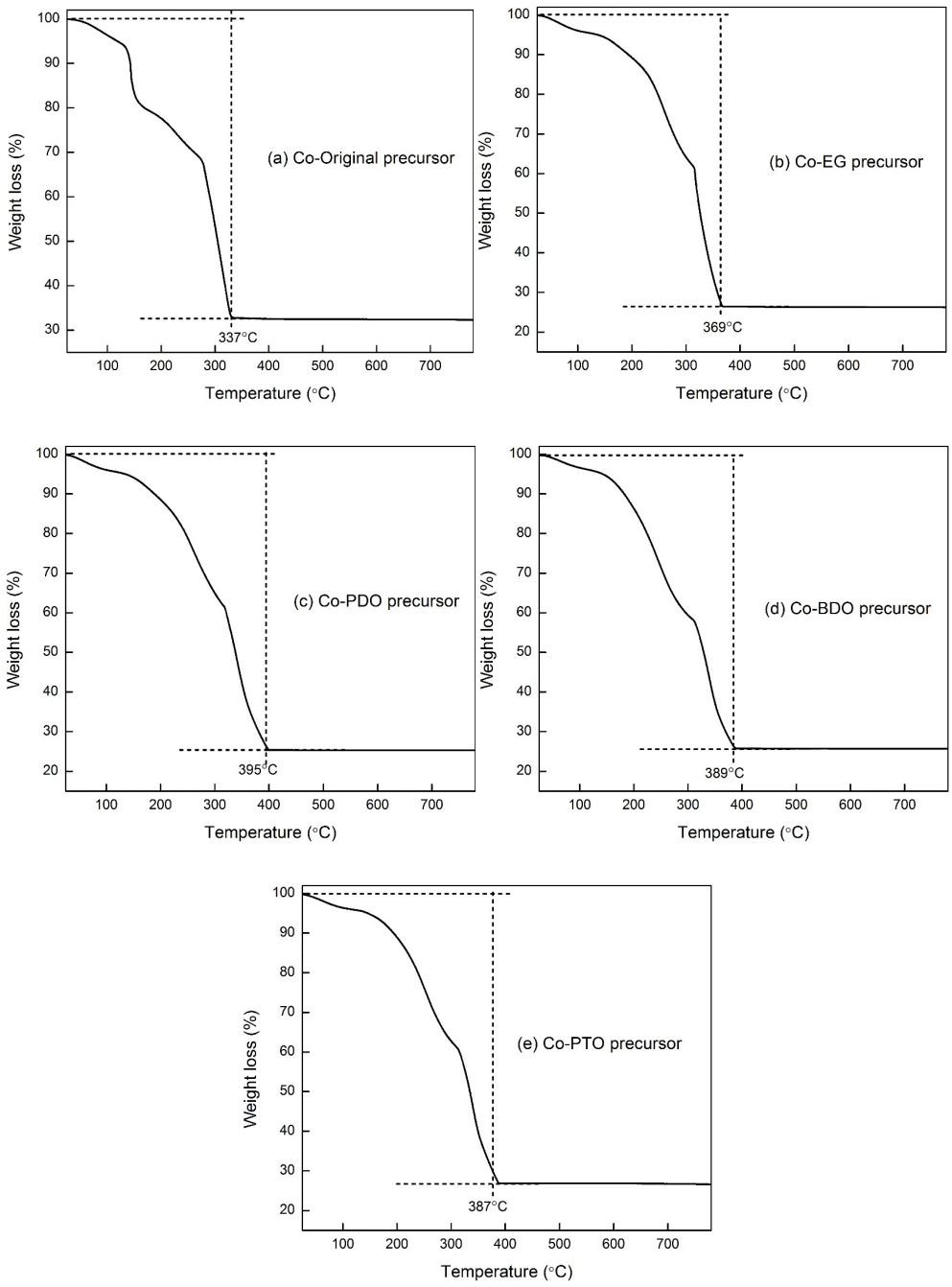

Fig. S1. TG curves of different catalyst precursors.

(a) Co-Original precursor; (b) Co-EG precursor; (c) Co-PDO precursor; (d) Co-BDO precursor; (e) Co-PTO precursor.

TG tests were carried out on five catalyst precursors. As shown in Fig. S1, all catalyst precursors have undergone the removal of water molecules and the decomposition of organic components within 400˚C. The Co-Original precursor did not show significant weight loss after 337 ˚C, indicating that the organic components have been completely released. After the addition of diol, the complete decomposition

temperature moved to a high temperature. Among them, the complete decomposition temperatures of Co-EG precursor, Co-PDO precursor, Co-BDO precursor, and Co-PTO precursor are 369˚C, 395˚C, 389˚C, and 387˚C, respectively. These results confirm that all catalyst precursors can achieve complete decomposition of organic components within 400 ˚C. Moreover, the catalyst was obtained by heating the precursor to 400 ˚C for 2h, which can ensure that the material does not contain undecomposed organic components.

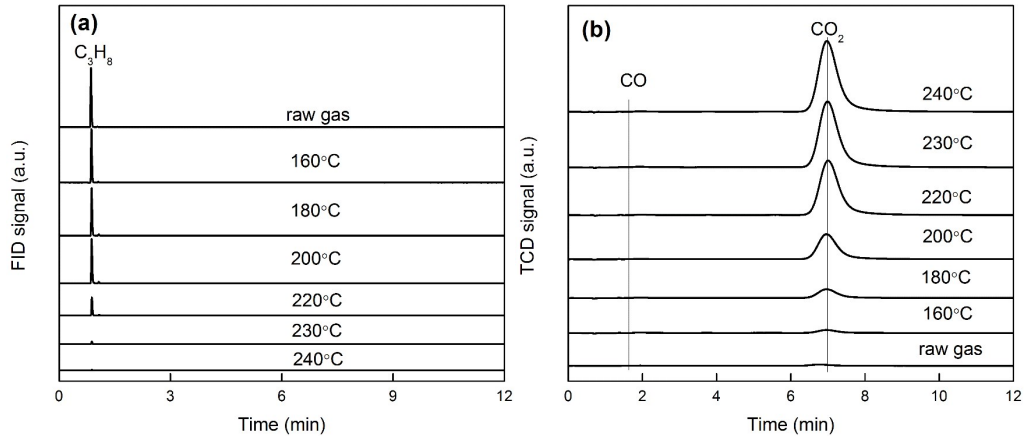

Fig. S2. Reaction tail gas composition (a) propane content; (b) CO and CO_2 content Test conditions: The feed consisted of 0.3 vol.% propane balanced by air, with a gas hourly space velocity (GHSV) of 30000 mL/(h·g).

Response: The propane oxidation products are shown in Fig. S2. In Fig.S2a, the FID detector only detects changes in propane content, which indicates that there are no other hydrocarbons in the feed gas and tail gas. As the temperature increases, propane is oxidized and its content gradually decreases. When the temperature reaches 240 ˚C, propane is completely oxidized. In Fig.S2b, the TCD detector detects the changes in CO (at 1.8min) and CO_2 (at 7min) content. During the whole reaction process, only the change of CO_2 content was detected, but no CO was detected, indicating that the propane was completely oxidized. Therefore, only propane and CO_2 were detected in this reaction, and the formation of related by-products such as hydrocarbons and CO was not detected, and no relevant discussion was conducted.

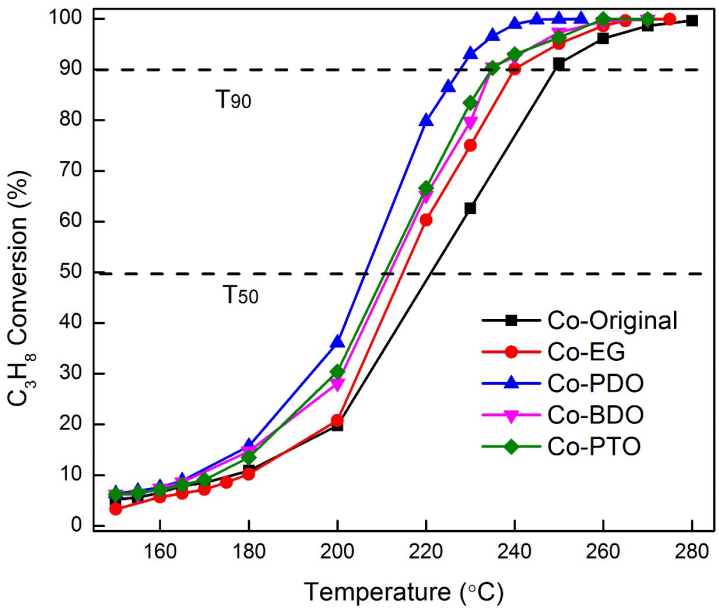

Fig. S3. Relationship between propane conversion and reaction temperature.

Response: As shown in Fig. S3, the relationship between propane conversion and reaction temperature is supplemented. As the temperature increases, the conversion rate of propane increases rapidly. The order of activity of the catalysts from large to small is Co-PDO> Co-BDO ≈ Co-PTO> Co-EG> Co-Original. Among them, Co-PDO has the best propane combustion activity, with T_{50} and T_{90} of 208˚C and 227˚C, respectively.

Table S1 Crystalline size of catalysts.

Sample	Co_3O_4 (220) plane (nm)	Co_3O_4 (311) plane (nm)	Co_3O_4 (400) plane (nm)	CoO (200) plane (nm)
Co-Original	18.1	17.5	16.8	/
Co-EG	12.6	11.9	13.4	13.6
Co-PDO	12.7	11.8	13.1	13.7
Co-BDO	11.6	11.1	14.9	15.9
Co-PTO	12.1	11.4	14.2	14.7

From the XRD pattern (Fig. 2), the crystal planes that can be identified and calculated in all catalysts include the (220), (311), and (400) crystal plane of Co_3O_4 and the (200) crystal plane of CoO. The crystalline size of the four crystal planes was calculated by the Scherer formula, and the corresponding results are shown in Table

S1. In Co-Original, the crystalline sizes of (220), (311), and (400) planes in Co_3O_4 are 18.1nm, 17.5nm, and 16.8nm, respectively. After adding diol compounds, the crystalline sizes of (220), (311), and (400) planes of Co_3O_4 in all catalysts are significantly reduced to 11.1nm-14.9nm. Meanwhile, the crystalline size of (200) plane belonging to CoO in Co-EG, Co-PDO, Co-BDO, and Co-PTO catalysts ranges from 13.6nm to 15.9nm.