Supporting Information

# Effect of Reduction Atmosphere on Structure and Catalytic Performance of PtIn/Mg(Al)O/ZnO for Propane Dehydrogenation

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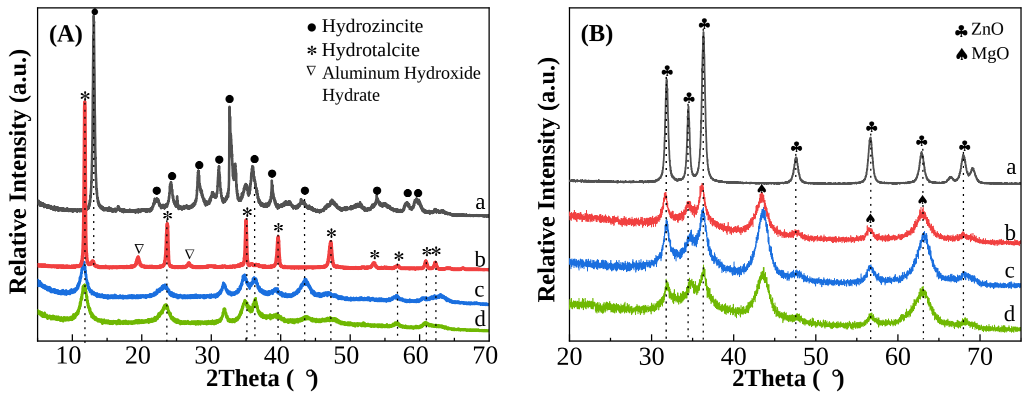


**Figure S1.** XRD patterns of precursors (A) and the corresponding calcined samples (B): (a) ZnO; (b) MAZ; (c) In/MAZ; (d) PtIn/MAZ.

According to the Figure S1(A), the single hydrozincite phase (JCPDS file No. 19-1458) is confirmed from the characteristic diffraction peaks. After hydrothermal treatment with the mixture solution of magnesium nitrate and aluminum nitrate, the strong characteristic diffraction peaks of hydrotalcite-like phase (HT, JCPDS file No. 35-0964) can be detected along with the appearance of some weak diffraction peaks of aluminum hydroxide hydrate (JCPDS file No. 39-0685) except the residual hydrozincite peak at low 2-theta degree. It indicates the MgAl(Zn)-HT is the main crystalline phase on the surface of hydrozincite. After two-step impregnating the calcined product with indium nitrate aqueous solution and chloroplatinic acid aqueous solution, some weak HT diffraction peaks can be indexed for In/MAZ and PtIn/MAZ precursor, suggesting the lattice distortion due to the influence of $In^{3+}$ and $Pt^{4+}$ ions. In addition, a slight shift can be seen for their (003) and (006) peak diffractions, this means that the $In^{3+}$ and $Pt^{4+}$ ions can be introduced into the reconstruction HT layer[1, 2]. As shown in

Figure S1(B), the hydrozincite phase can be successfully transformed into single ZnO phase (JCPDS file No. 75-0576), and the other samples present the diffraction peaks of MgO phase (JCPDS file No. 87-0651) after calcination. The $Al_2O_3$ diffraction peaks cannot be found, which is believed to be retained and located in interstitial sites in the MgO framework after calcination[3].

**Table S1.** Comparison of the catalytic performance of some state-of-the-art catalysts used in propane dehydrogenation.

| Catalysts | Pt loading (wt.%) | Reduction conditions | | | Reaction temp (°C) | WHSV ($h^{-1}$) | $X_i$[a] (%) | $Y_i$[b] (%) | Stable time[c] (h) |
|---|---|---|---|---|---|---|---|---|---|
| | | gas | temp (°C) | Time (h) | | | | | |
| PtIn/Mg(Al)O[4] | 0.6 | $H_2$ | 580 | 2.5 | 620 | 3.3 | 37 - 57 | 93 - 96 | 12 |
| Pt3Ga/CeAl[5] | 1.0 | $H_2/N_2$ | 500 | 1.0 | 600 | 10.0 | 41 - 33 | 99 | 10 |
| 15Zn0.1Pt/Al[6] | 0.1 | $N_2$ | 600 | - | 600 | 3.0 | 35 - 31 | 94 - 97 | 4 |
| PtCu/CeMgAl[2] | 0.6 | $H_2/N_2$ | 580 | 2.5 | 600 | 3.0 | 62 - 44 | 70 - 90 | 7 |
| PtSnK/ZSM-5[7] | 0.5 | $H_2$ | 500 | 8.0 | 590 | 3.0 | 34 - 33 | 92 - 93 | 8 |
| PtSnNa/Ce-MA[d][8] | 0.5 | $H_2$ | 500 | 8.0 | 590 | 3.0 | 34 - 28 | 85 - 96 | 6 |
| PtIn/MAZ[e] | 0.5 | $H_2/N_2$ | 600 | 2.5 | 600 | 3.0 | 32 - 51 | 97 - 92 | 25 |

[a] Propane conversion: "initial – highest or stable".

[b] Propylene selectivity: "initial – stable".

[c] The time of propane conversion higher than 40% or stable at a certain level when it is below than 40%.

[d] The synthetic mesoporous alumina (MA).

[e] The catalyst in this work.

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