Propane dehydrogenation over platinum and iron loading zeolite

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Propylene is one of important base chemicals in petrochemical industry. In recent years, propane dehydrogenation (PDH) has been a concern of researchers due to requiring a new propylene source with rise of ethane cracker. Propane dehydrogenation is an endothermic reaction, which requires a high temperature to gain high propylene yield. Since platinum supported on Al_2O_3 is a common dehydrogenation catalyst having low catalytic activity and durability [1], it is necessary to search a novel catalyst for PDH. We found that iron addition improved the catalytic selectivity of platinum supported on H-*BEA zeolite for *n*-heptane isomerization. In this study, we tried to apply such PtFe/zeolite to PDH and will report its novel catalytic property for PDH.

We prepared Pt and Fe-loaded zeolite by a liquid phase ion exchange method, using $Pt(NH_3)_4(NO_3)_2$ aq., $FeCl_3$ aq., Na-zeolites (Si/Al), FAU (2.75), *BEA (20), EMT (3.8), LTL (3.15), MOR (9.3), MTW (58), FER (9.0) and MFI (20). Figures in parenthesis indicated Si/Al ratio. Pt and Fe were also supported on γ-Al_2O_3 using an impregnation method. The amount of loading (Pt, Fe, Na, and Al) were determined by chemical analysis using ICP-AES. Catalytic tests were carried out in a fixed bed flow reactor at 773 K. The catalyst weight was 50 mg and the flow rate of reaction gas (C_3H_8/Ar=1/21) was 44 mL/min^{-1} (STP).

Fig. 1 showed the catalytic activities of 0.4 wt% Pt supported on Na-zeolites and γ-Al_2O_3 for PDH. All Pt/Na-zeolites exhibited lower propylene yields than Pt/γ-Al_2O_3. However, 1.5 wt% Fe addition on Pt/Na-zeolites and Pt/γ-Al_2O_3 dramatically enhanced catalytic activity for PDH as seen in Fig. 2. Catalytic activities of Pt/Na-zeolites having 12 member-ring micropores, for instance, FAU, *BEA, EMT, LTL, and MOR were particularly improved with Fe addition. Since 12 member-ring micropore is larger than hydrated Fe^{3+} in aqueous solution, it is possible that iron is loaded in the micropore of 12 member-ring zeolite. The XRD patterns assigned to Pt (111) crystal phase were observed for Pt/zeolites. Fe addition decreased the intensity of Pt (111), indicating that Pt dispersion was improved with iron addition and thereby the catalytic activity for PDH was enhanced.

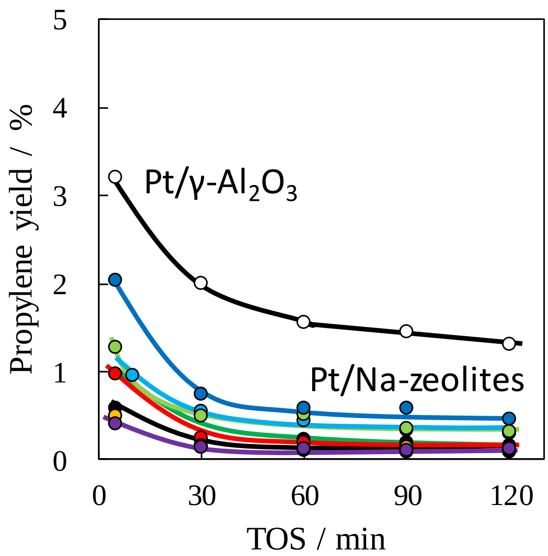

Fig. 1 Catalytic behavior of 0.4 wt% Pt loaded on various support for PDH.

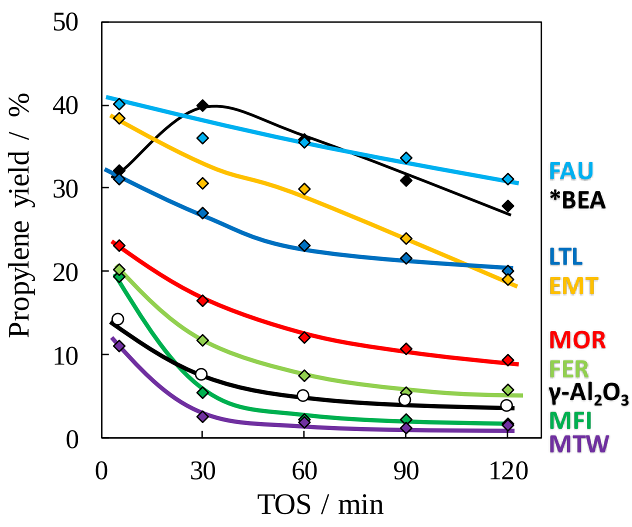

Fig. 2 Catalytic behavior of 0.4 wt% Pt/1.5 wt% Fe loaded on various supports for PDH.

REFERENCES

[1] O.A. Bariås, A. Holmen, and E.A. Blekkan, *J. Catal.*, 158 (1996) 1-12.