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Heat Treatment of Apatite-type Catalyst Particles Using a Fluidized Bed for Propane Oxidative Dehydrogenation

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Abstract

Hydroxyapatite ($Ca_{10}(PO_4)_6(OH)_2$, HAp) has been used as an industrial material as a HPLC adsorbent, acid-base catalyst, and as an ion exchanger. Recently, HAp containing small amounts of Fe (Fe-HAp) has been reported to exhibit higher activity than normal HAp in propane oxidative dehydrogenation (PODH) [1]. Since HAp possesses high ion exchangeability, it is possible to substitute some part of Ca site with useful catalyst metals. Our recent preliminary study on the Fe-HAp catalyst found that heat treatment under a reduced atmosphere can effectively promote catalytic activity. In addition, it is expected that catalytic activity of Fe-HAp can be enhanced by drip thermal treatment in a fluidized bed; a method which was once applied to the enhancement of catalytic activity of Ni-HAp in the partial oxidation of methane [2]. In this study, we aim to develop unprecedented high activity HAp catalyst by specifying metal active species suitable for substitution to HAp and conducting fluidized bed thermal reduction treatment. HAp catalysts containing various metal species (M-HAp) as catalytically active species were prepared using a fluidized bed.

HAp catalysts containing various metal species as catalytically active species were prepared by adding the metals to either acid solution including P or base suspension including Ca with a constant molar ratio of Ca/M = 9/1 keeping a stoichiometric ratio of Ca/P to be 1.667. This study clarified that M-HAp catalysts showing higher catalytic activities so far were successfully prepared as compared with other catalysts reported in the literature. In particular, HAp catalysts with cobalt, vanadium and molybdenum incorporation showed better catalytic activity in PODH (Fig.1).

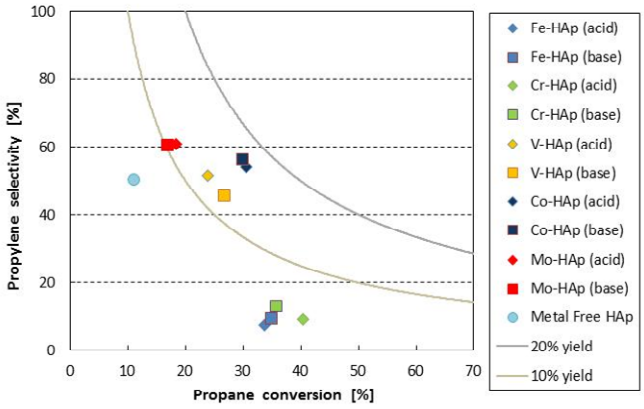

Figure 1. Propane conversion and propylene selectivity for M-HAp catalysts prepared in this study.

References

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