

CHAPTER I

INTRODUCTION

Catalytic oxidative dehydrogenation of propane has received extensive research efforts in recent years [2]. Because propylene is an important intermediate in the petrochemical industry largely requested to produce polypropylene, acrylic acid, acetone, etc. The increasing demand for propylene in the industrial market and the interest in using a cheaper source such as propane has led to an increase in the research on the oxidative dehydrogenation of propane [1].

Oxidative dehydrogenation is a petrochemical process that is still only in a period of research and development in laboratory. It will take sometimes before it can become the real practical process in the petrochemical industry. Because of it relatively new alternative in this field, there is no much information available about this process. There are many conjectures and presumption that are still not clear and waiting to be exactly demonstrated such as confusion of the true situation about with kind of source of oxygen that is active and selective for oxidative dehydrogenation.

The oxidative dehydrogenation of propane could be much more convenient than the direct dehydrogenation requiring very high temperatures (a strongly endothermic process temperatures $>600\text{ }^{\circ}\text{C}$) at which coking phenomena and catalyst deactivation normally occur. On the contrary, oxidative dehydrogenation is thermodynamically feasible at all temperatures, but requires selective catalysts in order to avoid the complete oxidation to CO and CO₂ [1, 3].

One of the main requirements for a selective catalyst in oxidative dehydrogenation of lower alkanes is to ensure easy desorption of an olefin molecule from a catalyst surface, before it undergoes consecutive total oxidation to carbon oxides. The strength of bonding of an olefin (a base or a nucleophile) should depend on acid–base properties of a catalyst surface, being weaker on the surfaces of low acidity (low acid strength) and high basicity (high base strength). The systems of such properties should facilitate the olefin desorption and hence should be selective catalysts for the oxidative dehydrogenation of alkanes to olefins. In the case of transition metal oxides, catalyzing reaction with one-electron transfer, the notions of Lewis acidity and basicity are frequently used as equivalent to, respectively

electrophilicity and nucleophilicity, and related to the density of electrons over cations (acid or electrophilic centres) and oxide ions (basic, nucleophilic centres). The acid–base properties of an oxide catalyst can be controlled by the introduction of additives [4].

The oxidative dehydrogenation of propane usually takes place Mars van Krevelen mechanism involving in the oxidation state vary of cation and the transfer of oxygen species. The redox properties have obviously important effect on the activity and selectivity in oxidative dehydrogenation of propane [5]. The most studied catalysts for propane conversion are based on vanadium, metal molybdates and phosphates [1].

Supported noble metal catalysts are not suitable for oxidative dehydrogenation since they prefer combustion reaction of organic compounds. The metal oxide catalyst system seems to be more appropriate since the oxidation can be proceed via reaction between lattice oxygen of oxide and adsorbed hydrogen molecule. It is know that oxidation by a lattice oxygen of oxide tends to produce selective oxidation products rather than combustion products as in the case of adsorbed oxygen species. Several oxide systems, for this reason, have be come a subject of to fond a suitable catalyst for the oxidative dehydrogenation. Among several systems investigate; V-Mg-O catalyst has received more attention than any in the oxidative dehydrogenation. This is due to the nature of this system that can produce a significant amount of alkene with out oxygenate formation, thus reducing separation cost.

In this research zinc gallate (ZnGa_2O_4) and zinc alminate (ZnAl_2O_4) were user as catalysts in oxidative dehydrogenation of propane, spinel type structure have double oxide, higher surface area and high thermal stability. [20]

Hence, this work was set up to investigate: The effect of ZnGa_2O_4 and ZnAl_2O_4 spinels type catalysts on oxidative dehydrogenation of propane to propylene.

The presents study is arranged as follow:

Chapter II presents literature reviews on the oxidative dehydrogenation of propane.

Chapter III. The theory, study about the oxidative de hydrogenation of propane, the properties of ZnGa_2O_4 and ZnAl_2O_4 catalysts, are described.

Chapter IV presents the experimental systems and operational procedure.

Chapter V shows the experimental results of characterization of catalysts and the propane oxidative dehydrogenation over ZnGa_2O_4 and ZnAl_2O_4 catalysts.

In the last chapter, the overall conclusion emerged from this work is presented.

Finally, the sample of calculation of catalyst preparation, calculation of reactant flow rate, calculation of checking explosive limit of propane in air, calculation of BET surface area by the single point method, data of experiment are included in Appendices at the end of this thesis.



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