CHAPTER I
INTRODUCTION

1.1 Introduction

The use of bimetallic catalysts stems from the beneficial effect of the interaction between the two metals, which leads to the enhancements in both activity and selectivity. Catalysts are generally termed "monometallic" or "bimetallic" depending on the number of transition metals that are present in the catalyst in their metallic and/or oxidic state. One type of bimetallic clusters extensively investigated is a combination of a group VIII and a group IB metal. The bimetallic system used in this work was ruthenium-gold. The gold content and the nature of the support were varied in order to determine the effect of gold content on the catalytic reactivity. Temperature-programmed desorption (TPD) of oxygen and oxygen containing organic solvents such as alcohols, aldehydes and ethers are generally used to characterize these bimetallic catalysts. It determines the number, type, and strength of active sites available on the surface of a catalyst by the measurement of the amount of gas desorbed at various temperatures. Under the presence of different active metals, the interaction between these two metals in bimetallic catalysts will be responsible for the desorption of the reacted species at different temperatures. The oxygenated compound used in this work was methanol, which is the simplest compound. Temperature-programmed reduction (TPR) was used in this work to determine the number of reducible species present in the catalyst and to reveal the temperature at which the reduction occurs. It also indicates whether there is an interaction between the two metals components in the bimetallic catalysts. Moreover, the other characterization methods were employed including BET surface measurement, scanning electron microscopy

(SEM), and X-ray diffraction(XRD) measurement in order to gain more understanding of the morphology of these bimetallic catalysts.

In addition, this research work also investigated the oxidation of oxygenated compounds focused on methanol, using bimetallic catalysts, which is useful for VOCs removal in the chemical industry.

1.2 Research Objective

The objective of this work was to develop a comprehensive database for the surface interactions of oxygenated compounds with mono-and bimetallic ruthenium catalyst surfaces as a function of temperature and gold content. The oxygenated compound used in this work was methyl alcohol, which is one of the most important chemical intermediates used in industrial chemistry. The mono-and bimetallic catalysts of Ru/SiO_2, Au/SiO_2, $Ru\text{-}Au/SiO_2$, $Ru/\eta\text{-}Al_2O_3$, $Ru/\gamma\text{-}Al_2O_3$ and $Ru\text{-}Au/\eta\text{-}Al_2O_3$ with different gold and ruthenium contents were investigated to determine the effects of the gold content and the support. Temperature-programmed desorption (TPD) of oxygen and methyl alcohol was carried out on the mono-and bimetallic catalysts. Temperature-programmed reduction (TPR), BET surface area measurement, and scanning electron microscopy (SEM) were also employed to characterize the catalysts. In addition, the oxidation of methyl alcohol was studied in a continuous flow reactor containing these different catalysts. The oxidant used was a 21% oxygen stream, which is similar to practical situation for industrial application.

The outcomes of this studied work directly provide better fundamental understanding of the volatile organic compounds (VOCs) catalytic oxidation and the bimetallic catalysts. This will lead to develop the better bimetallic catalysts for VOCs removal.