



## Synthesis and Characterization of Heterogeneous Catalysts from Magnetic Sand and Kaolin

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### ABSTRACT

In this study, magnetic sand and kaolin obtained from the Nigerian states of Adamawa and Bauchi, respectively, were impregnated and studied for the catalytic property of the hybrid material. The SEM micrograph showed pore structures consistent with catalyst materials. X-ray fluorescent data showed the presence of various dopant-like impurities in the sample which act to substitute some parts of essential atoms in the spinel structure, however, not forming another individual phase. X-ray diffraction analysis confirmed crystalline phases of the hybrid material being kaolinite ( $\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4$ ), muscovite ( $\text{K}_4\text{Al}_2\text{Si}_2\text{O}_{10}$ ) and quartz,  $\text{Si}_3\text{O}_6$  minerals with an average crystallite size of 74.60 nm.

## 1. Introduction

Catalysis is the key to chemical transformations. Most industrial syntheses and nearly all biological reactions require catalysts. Furthermore, catalysis is the most important technology in environmental protection, i. e., the prevention of emissions [1]. A suitable catalyst can enhance the rate of a thermodynamically feasible reaction but cannot change the position of the thermodynamic equilibrium [2].

Heterogeneous catalysis involves systems in which catalyst and reactants form separate physical phases [2]. Heterogeneous catalysts exhibit many advantages, such as environmentally friendly, easy separation, and simple post treatments [3].

Heterogeneous catalysis was first observed by Berzelius and Mitscherlich, who determined that reactions could be fastened by solids. In 1895, the definition of catalysis as the acceleration of chemical reactions by the presence of foreign substances, which are not consumed was proposed by Ostwald. Progress in catalysis is connected with Paul Sabatier who was awarded the 1912 Nobel

Prize for his work on the hydrogenation of ethylene and carbon monoxide over Nickel and Cobalt catalysts. No less than 15 Nobel prizes have been awarded for studies on catalysis and many chemists around the world are repeatedly advancing the catalysts they have, and are motivated to discover new ones [10].

Kaolin clay is a cheap and versatile raw material which can be found in numerous geographical locations and has been used successfully in the synthesis of mesoporous aluminosilicates [4] and a host of microporous zeolite frameworks [5-9].

## 2. Results and Discussion

### 2.1. Scanning Electron Microscopy

The morphological characteristics of the solid particles as observed by Scanning Electron Microscopy (SEM) are depicted in Figure 1. It can be seen that the material has a layered structure and a two-dimension porous structure with small basal spacing. The layers were clearly kept apart, giving rise to large pore structures as shown in the micrograph.

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