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Transesterification of soybean oil to biodiesel using SrO nanoparticles as a solid base catalyst

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ABSTRACT

SrO nano oxides was prepared by sol-gel method and used as a basic heterogeneous catalyst for transesterification of soybean oil with methanol to methyl esters (biodiesel). The catalyst was characterized using X-ray diffraction (XRD), scanning electron microscopy (SEM and Fourier transform infrared spectroscopy (FTIR) techniques. It was found that using 1% (based on the soybean oil weight) of the catalyst, methanol to oil molar ratio of 15 produced biodiesel in excess of 99% at 60℃ within 15 min.

Keywords: *Biodiesel, SrO nano oxides, Tranesterification, solid catalyst*

1. *INTRODUCTION*

Compared to petroleum based diesel, biodiesel is an alternative fuel derived from vegetable oils or fats, which is biodegradable and non-toxic. In recent years, global warming, environmental pollutions, and depletion of fossil resources due to heavy consumption have become major issues of global dimensions. Biomass energy is expected to resolve these issues and has gained international attention as a source of renewable and environment-friendly energy [1, 4]. Biodiesel is a mixture of fatty acid methyl esters (FAMEs), produced by transesterification of triglycerides with methanol or other short chain alcohols in the presence of an appropriate catalyst [5]. Transesterification reactions are commonly catalyzed by acids or bases or carried out in the presence of enzyme catalysts [6]. Compared to acids, utilization of basic catalysts are most common since transesterification reaction proceed faster with moderate conditions [7]. Sulfuric or hydrochloric acid as catalyst has usually been used in acid-catalyzed processes. In these reactions, a high molar ratio of methanol to oil is required and reaction times are usually longer. Furthermore, acidic catalysts are corrosive and non-green [6, 8].

The cost of biodiesel could certainly be reduced by using heterogeneous catalyst. At the end of process, the eco-friendly heterogeneous catalyst is separated from the product by filtration and can be re-used in another reaction [9, 10].

So far, a variety of heterogeneous catalysts including microporous materials like zeolites [11, 12] mesoporous materials such as MCM-41 [13] layered materials like clays [14], and hydrotalcites [15] as well as other inorganic oxides such as zirconia [16], alumina either in pure form [17] or doped with an alkali metal hydroxides (NaOH or KOH) and salts [18] have been investigated in laboratory scale for transesterification of vegetable oils. Alkaline earth metal oxides are active for biodiesel production.The order of activity among alkaline earth oxide catalyst is BaO> SrO> CaO>MgO. Whereas SrO shows excellent catalytic activity due to its strong basicity in comparison to CaO and MgO [19, 20]. Herein, we report the preparation of *SrO nano oxides* as a basic heterogeneous catalyst for transesterification of soybean oil. Optimization of reaction parameters such as reaction time, molar ratio of methanol to oil, amount of catalyst and its effect on the quality of the produced biodiesel will be described in this presentation.

2. *EXPERIMENTAL*

2.1 Material

Soybean oil was obtained from Sigma. The soybean oil composition was calculated by “AOCS Ce 1-62” method. Strontium nitrate was purchased from Aldrich. Dichloromethane, methanol, n-hexane, isopropanol, and methyl heptadecanoate (>99 wt.%) as the GC standard were purchased from Merck Chemical Company. All chemical materials were used without further purification.