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**Preparation of novel carbonaceous solid acids from rice husk and phenol**Ming-Lin Guo<sup>a,\*</sup> Xue-Yan Yin<sup>b</sup> Juan Huang<sup>a</sup>

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**Abstract**

We reported a simple protocol to prepare a novel carbonaceous solid acid (CSA) with SiO<sub>2</sub> from a mixture of rice husk and phenol by using small amount of sulfuric acid while stirring and heating for dehydration, sulfonation and carbonation at 240 °C for 2 h. It was found that adding phenol was vital for enhancing properties of the obtained CSA, and the CSA was efficient and recyclable catalyst for production of biodiesel, with the conversion of oleic acid reaching 94.3 % at 65 °C for 4 h. Moreover, the conversion still was 90.2 % after the CSA had been used five times.

**Keywords:** rice husk; phenol; carbonaceous solid acid; carbon materials; amorphous materials; biodiesel

**1. Introduction**

Carbonaceous solid acids (CSAs) have received considerable attention due to their excellent catalytic activities, easy separation, high thermal stability and reusability in various acid catalyzed reactions [1]. Hara [2] synthesized the first CSA using sulfuric acid to partially carbonize and sulfonate naphthalene. Toda [3] conducted the pyrolysis of glucose and sucrose at 400 °C, followed by sulfonation to obtain the biomass-based CSA. Since then, many researchers explored biomass materials, such as bamboo [4], lignin [5] etc. to prepare CSAs. However, these experimental conditions were relatively harsh, usually required high temperature, longer reaction time and/or large volumes of sulfuric acid. Therefore, there is a need to synthesize reusable, inexpensive, and water-tolerant solid acid catalysts with strong active sites by employing simple protocols.

On the other hand, rice husk (RH) is an important biomass resource and rich in hemicellulose, cellulose, lignin, and SiO<sub>2</sub>. But, most of RH is directly burnt off as solid waste. Few reports were found to use RH for preparation of CSAs to date. In this work, development of an easy method for the preparation of CSAs from RH was explored. When RH was employed as raw material to prepare the

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