Chapter 7
Biomass-Derived Activated Carbon: Synthesis, Functionalized, and Photocatalysis Application

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ABSTRACT

The focus is to highlight the catalytic technologies to convert lignocellulosic biomass into the activated carbon (AC) which can be used in photocatalysis applications. The drawback of carbon production raised by energy assumption and product selectivity has encouraged the development of sustainable carbon synthesis process, where the catalytic approach is considered. This treatment via either homogenous or heterogeneous catalytic approach relative in mild condition provided a bulk, mesoporous and nanostructure AC materials. Those characteristics of AC materials are basic requirements for the efficient photocatalytic system. Due to the excellent oxidizing behavior and stability, semiconductor materials have been widely used in the photocatalytic system. However, they lead to some drawbacks in terms of the separation steps and loss of the photocatalyst. So, attention has been paid to supported semiconductor catalysts which carbon materials were explored. AC reported as a potential support in photocatalytic systems.

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1. INTRODUCTION

Rising environmental concerns and the need for cost-effective competitive products are becoming two major guidelines in modern material research (Baleizao et al. 2002). Previously developed routes to obtain a periodic porous carbon network were successful, but again did not take into account any criteria of sustainability (Kuzyakos et al. 2009). In the past 20 years, many of laboratories of research institutions have had some in-depth researches on the biomass conversion to carbon-based materials without catalysts (Demirbas 2001). Their studies covered some typical carbon material model compounds, such as glucose, methanol, cellulose, lignin and some real biomass compounds (Hamer et al. 2004). As successful demonstrations accumulated, detailed reaction mechanism, kinetics, and thermodynamics have built a solid foundation for subsequent investigations (Onal et al. 2004). However, to increase the selectivity of carbon materials production, high activation energy is needed for the reaction without a catalyst. The high costs of equipment and operations have undoubtedly become the biggest obstacle to the development of this technology (Manya et al. 2003).

Therefore, the problem of carbon synthesis under sustainable conditions was recently revisited and implemented by several terms, where catalytic treatment of biomass via either homogenous or heterogeneous system relatively in mild condition provided bulk, mesoporous or nanostructured carbon materials (Carlson et al. 2008). The catalytic effect of homogenous catalyst, especially ionic liquid on the biomass conversion has been confirmed by many of open literature. Main characteristics of this catalytic technique are to have a conversion system with minimum energy to confirm the high yield of carbon materials. Compared with the homogeneous catalyst, heterogeneous catalysts have the advantages of high selectivity, recyclable and environmentally friendly. Thus, a heterogeneous catalyst with the wide range of solid acid, ion exchange resin, zeolite and metal oxide has become a research hotspot in this field. Both techniques have been explored extensively, with the need for exploring cheap and sustainable ways to obtain chemicals and carbon from raw materials other than crude oil or natural gas that could lead to a re-exploration of this field. In addition, the implementation of the low-cost pathway to recycle by-products of farmed biomass would additionally represent a way to sequester a significant amount of CO$_2$ creating a material benefits at the same time (Tessonnier et al. 2009).

This paper will not discuss on the preparation of the catalyst, but instead, focus solely on the use of a catalyst to bring about carbon based materials via a conversion process of biomass, which can be further used as a photocatalysis applications.

Several published papers and review articles have cited the theory and environmental applications of heterogeneous photocatalysis by the use of semiconductors (Chong et al. 2014; Zhang et al. 2014). One of the biggest disadvantages of using...
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