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ORIGINAL PAPER

Activated Carbon for Catalyst Support from Microwave Pyrolysis of Orange Peel

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Abstract Orange peel, representing an abundant fruit waste in Asia, was transformed into activated carbon via the use of microwave pyrolysis. The orange peel was first subjected to microwave pyrolysis over a range of microwave power in order to produce an optimal yield of activated carbon as the target product. The activated carbon was extensively characterized for its porous characteristics, N_2 adsorption and desorption isotherms, thermal stability, and chemical composition in order to assess its potential to be used as a catalyst-support material. Microwave pyrolysis of orange peel showed an approximately 70 wt% yield of activated carbon over the range of microwave power considered. The activated carbon was detected to have a high BET surface area associated with type I isotherm, which indicates the presence of microporous structure, thus exhibiting a characteristic of high adsorption capacity. The high adsorption capacity suggests that the activated carbon produced using this pyrolysis approach could act as an adsorbent to adsorb metal ions, therefore it shows great potential to be used as a catalyst-support material—the base material to which catalytically active substance such as metal binds to form a heterogeneous catalyst. The activated carbon also demonstrated high thermal stability in N_2 atmospheres, representing a durable material to be synthesized into a catalyst for use in thermal process. Our results show that the activated carbon produced from microwave pyrolysis of orange peel shows exceptional promise as a catalyst-support material.

Keywords Activated carbon · Catalyst · Catalyst support · Chemical activation · Microwave pyrolysis · Microwave power

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Introduction

Orange represents one of the popular fruits in the world due to its high nutritional contents [1]. According to statistics, the global production of orange was approximately 70 million tons in 2015 and the production continues to increase in order to meet the market demand [2]. As a result, large amounts of orange peel (OP) have been generated as a waste. The OPs are currently disposed through landfilling, which leads to production of methane as greenhouse gases that can cause global warming [3].

Efforts have been made to divert OP from landfilling by re-using it as a feedstock for extraction of essential oil [1, 4]. The extracted essential oil from OP could be added as additives or flavoring into carbonated drink and ice-cream, or it can be refined into antioxidant material for