

Controlled Synthesis of Nano- and Micro-sized Carbon Materials and Their Uses

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Introduction

In the past decade, carbon nanomaterials have drawn much attention because of their unique structure and properties. This presentation consists of three parts. In the first part we will report the controlled synthesis of several kinds of carbon nanomaterials from coal under plasma conditions, which include multi-walled carbon nanotubes (CNTs), single-walled CNTs, double-walled CNTs, Y-branched CNTs, Carbon coated Cu nano-wires, carbon-encapsulated nano-sized iron group metals. X-ray diffraction, Raman spectroscopy, scanning electron microscopy and transmission electron microscopy have been used to study the nanostructures of the synthesized carbon nanomaterials. The results show that the yield, structure and properties of the synthesized nanocarbons are closely related to the coal type and the loading amount of catalysts. A possible formation mechanism of coal-based carbon nanomaterials is proposed. The possibility and feasibility of producing high quality carbon nanomaterials from coal are addressed in terms of coal properties and other process parameters. In the second part, a novel process for controllable synthesis of microcarbons such as microtubes made of *in situ* formed MWCNTs from hydrocarbons is discussed. In the third and final part, the application potential of the carbon nanomaterials is demonstrated with three successful examples: MWCNTs as catalyst support for direct methanol fuel cells; MWCNT-supported noble and iron group metal catalysts for hydrogenation and hydroformylation reactions; and carbon-encapsulated nanometals as adsorbent for removal of sulfur species from oil. In these processes the role of carbon nanomaterials will be highlighted in terms of their unique morphologies and properties.

Keywords: Carbon nanomaterials; Carbon micromaterials; Preparation; Uses