International Journal of Engineering Inventions
e-ISSN: 2278-7461, p-ISSN: 2319-6491
Volume 8, Issue 8 [August 2019] PP: 45-47

Synthesis of carbon nano materials from *Madhuca longifolia* (Mahua) seeds as precursor using CVD method

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ABSTRACT
Madhuca longifolia (Mahua) seeds are non-edible oil rich plant product, with many medicinal properties. Carbon nano materials being a new type carbon material were synthesized from Madhuca longifolia seeds (as biological precursor) by single zone CVD method. During pyrolysis, Hydrogen (H_2) gas was used as a carrier gas, and temperature was maintained 1000^0C for three hours. Scanning Electron Microscopic (SEM) images confirmed the morphology of nano sized plate like structures along with some nano-carbon fragments were present.
KEYWORDS: *Carbon nano materials, Madhuca longifolia (Mahua) seeds, CVD method*

I. INTRODUCTION

Plants are of immense importance for human beings since the civilization. They have been exploited for various purposes viz. food, medicine, fuels, shelter, textiles, dyes etc. With the advancement of science, a new field known as Nanotechnology has emerged. Plants being a rich source of hydrocarbons synthesize large amounts carbon nano materials as precursors. Nano carbon is being synthesized from hydrocarbons derived from fossils fuels; however, there is the limited existence of fossils fuels on the earth. Plant materials are renewable resources and can be cultivated as per the requirements. Moreover, CNM being derived from non edible seeds would reduce the cost of its production. Since the end of twentieth century Sharon et al. has been working on using the plants derived materials for the synthesis of carbon nano materials (CNM).

Use of plant derived products like camphor, oil, non-edible plant parts, resin etc as precursor for the synthesis of Carbon Nano Material (CNM) have been made earlier [1]. Plant derived products as well as plant tissues contain oil, carbohydrate, protein etc which are rich source of hydrocarbon. There are several reports on the preparation of Carbon Materials (CM) from agro-by-products or wastes, such as seeds of grape [2], cherry stones [3], straw of corn [4], hull of peanut [6], cotton stalk [7], peach stones [8].

In present decade the novel carbon materials have been the focus of attention by researchrs because of their morphology, physical and chemical properties like carbon micro trees [9], mesoporous carbon [10], carbon nanohorns [11], coin-like carbon materials [12], carbon sphere [13], and so on. Carbon nano-flakes as a by-product of synthesized carbon nano-tubes were first reported by Ebbesen and Ajayan in 1992 [2]. Carbon nano-flakes have been prepared by novel synthesis methods for their application in past several years [14].

The present work is also focused on using Madhuca longifolia (Mahua) seeds as a source of hydrocarbons for use as precursor for the synthesis of CNM by using single zone CVD method.

II. MATERIALS AND METHODS

Precursors used were seeds of Madhuca longifolia (Mahua), were procured from local market. The seeds of *Madhuca longifolia* were washed with distilled water and then dried in an vacuum oven at 600C for 6 hrs and then crushed into powder form with the help of mortar and pestle. Powder was stored till further use at room temperature.

Pyrolysis set-up: Single zone CVD furnace was used for pyrolysis of seeds. Quartz tube placed inside the furnace was used as a reactor. A flow meter was used for controlling the flow rate of carrier gas and bubblers were used for preventing the back suction into quartz tube during pyrolysis. The schematic of CVD set-up is presented in fig. 1. Known amount of the seed powder was taken as precursor into a quartz boat for pyrolysis. To make the furnace oxygen free Hydrogen (H_2) gas was used. Pyrolysis was done at 1000^0C temperatures for 3hrs duration.

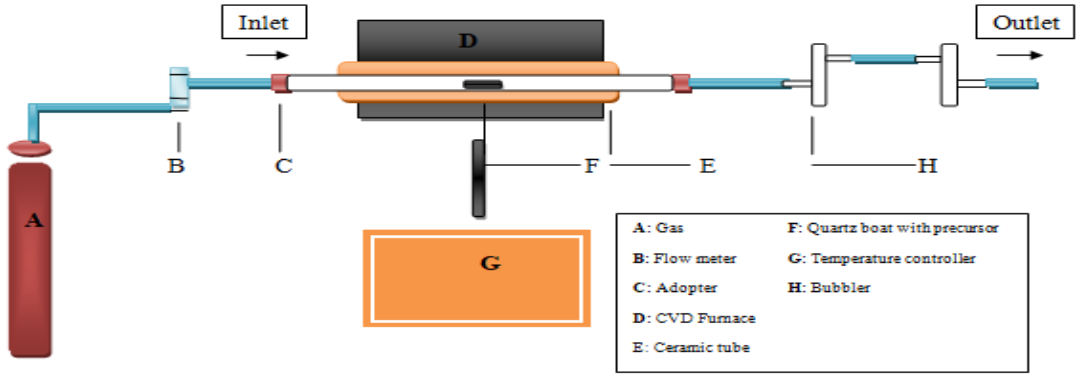

Fig. 1. A Schematics of Single zone Chemical Vapour Deposition (CVD) Apparatus

Pyrolysis of seed powder: 5g crushed seed powder was taken in a quartz boat and kept inside the quartz tube then both the ends of furnace were fitted with adopters which were connected with inlet and outlet pipes. The desired carrier gas was purged inside the quartz tube at high flow rate (150 ml/min) for 15 minutes to remove the oxygen. Then gas flow was continued at slower rate (25 ml/min) during pyrolysis. After purging, the desired pyrolyzing temperature and duration of pyrolysis was set. Once the pyrolytic reaction was over, the furnace was allowed to cool down to room temperature. The pyrolyzed carbon material was subsequently collected from the boat.

Purification of carbon: Lumps of carbon collected from the quartz boat were powdered for acidic purification [15] to get rid of any metal or other residual materials. Mixture of carbonized seeds and 6 M HCl were thoroughly mixed and were kept for 2 hrs, and then filtered. The powder was then dried by keeping at 60^0C for 6 hrs. Dried powder was stored for further investigations.

Characterization of carbon nano materials

The morphological observation of finally prepared CNM obtained from *Madhuca longifolia* seeds as precursor was observed by Scanning Electron Microscope (SEM).

III. RESULT AND DISCUSSIONS

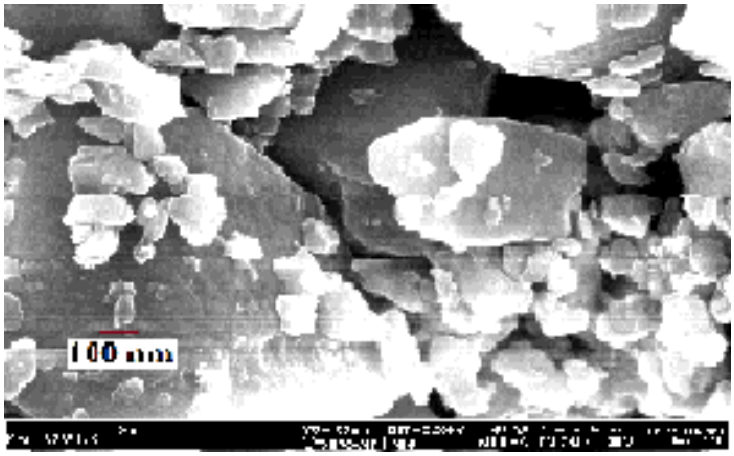

Fig. 2. SEM image showing Carbon nano materials from pyrolysed *Madhuca longifolia* Seeds

The SEM micrograph of pyrolysed carbon nano materials (CNM) of *Madhuca longifolia* seeds (fig. 2) showed mixed size structure (100-1500 nm) with smaller fragments (25-100 nm). The morphology of CNM was found smooth plate like structures. In another investigation [16] had synthesized chain of carbon nano beads from castor seeds as precursor, however, utilizing Argon gas at 900^0C with Iron as catalyst.

IV. CONCLUSION

The plate like carbon nano materials from biological precursor (*madhuca longifolia* seeds) have been synthesized by single zone chemical vapour deposition (CVD) furnace, which is an inexpensive source and the method can be further scaled up making it more viable way for obtaining bulk material of carbon nano materials which was confirmed by using Scanning Electron microscopy (SEM).

ACKNOWLEDGEMENT

Authors wish to acknowlegde the finencial and laboratory support provided by the authorities of nsnRc, SICES college, Ambernath and also specially thanks to University Department of Botany, T. M. Bhagalpur University, Bhagalpur for laboratory.

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