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Short Communication

Synthesis of Nano Composites from Plant-based Sources

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Abstract

Nano-particles for pharmaceutical purposes are defined as solid colloidal particles ranging in size from 1 - 1000 nm (1 mm). They consist of macromolecular materials and can be used therapeutically as drug carriers, in which the active principle (drug or biologically active material) is dissolved, entrapped or encapsulated, or to which active principle is adsorbed or attached. Nature provides numerous fibrous and porous materials from which materials at nano range can be accessed easily. In the present paper, a qualitative aspect of synthesis and characterization of composite materials derived from plant based sources such as cane sugar and bond paper are discussed.

Key Words: Bond paper, cane sugar, inorganic composite.

Introduction

Nano-scale regime is probably the nature's choicest region of materials to carry out most of its finest processes[1-3]. Materials in nano-domain exhibit a host of remarkable properties, unusual in the bulk material [3-5]. A large number of key natural/biological processes take place in the nanometer scale regime. Therefore, a confluence of nanoscience and biology can address several biomedical problems, and can revolutionize the field of health and medicine[4-8]. The new age drugs are nanoparticles of polymers, metals or ceramics, which can combat conditions like cancer and fight human pathogens like bacteria[9,10]. Thus it is of great interest to synthesize the materials from naturally occurring fibrous material [11-13]. However, producing such materials in commercial volume at viable market price is a challenging task [14, 15]. We report herein nano structured inorganic composite materials obtained from plant-based sources such as burnt paper and charred sugar.

Material and Methods

The raw materials used for the synthesis are A4 size bond paper and 1 g cane sugar. The synthetic strategies adopted are as follows:

Synthesis of material from bond paper (Material 1): An A4 size bond paper is dried in sunlight, crushed and burnt in open air at 200^0C using a Bunsen burner for half an hour. The carbon and other volatile oxidizable material volatilizes under that condition. The white leftover ash is treated with hot and concentrated sulphuric acid and washed repeatedly with distilled water to remove any sulphate and hydronium ions. The white ash left after is analyzed as material 1.

Synthesis of material from cane sugar (Material 2): 1g of cane sugar is taken which is finely crushed into powder. The powdered material is then charred with hot and concentrated sulphuric acid with constant stirring. After a week, a black colloid appeared which is coagulated under gravity. The coagulated product is washed repeatedly with distilled water to remove the sulphate and hydronium ions. The black powder thus obtained is dried over an oven at 50^0C for 2 hours to obtain the material 2 for analysis.

The morphologies of the synthesized materials have been studied using scanning electron microscopy (SEM) and elemental composition by energy dispersive spectroscopy (EDS).

Results and Discussion

The synthesized materials are found to be air and moisture stable and insoluble in water, methanol, toluene, hexane and carbon tetrachloride. However both are dispersible in chloroform.

SEM Studies of the synthesized materials: Material 1: The synthesized material exhibits flake like domains as seen from its SEM image. The thickness of the flakes is recorded to be in the range 100-200 nm.

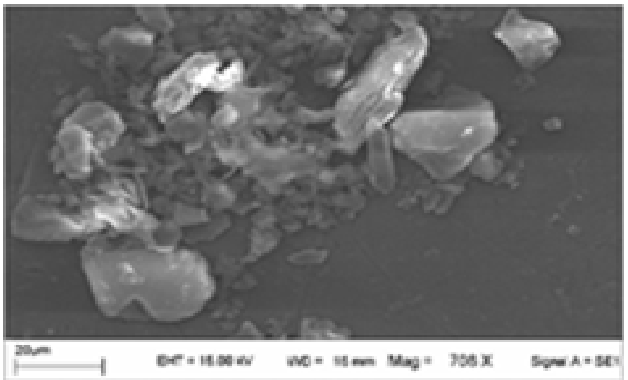

Figure-1(a)

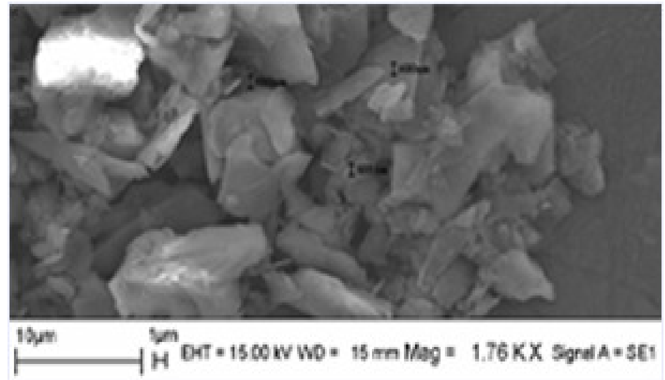

Figure-1 (b)

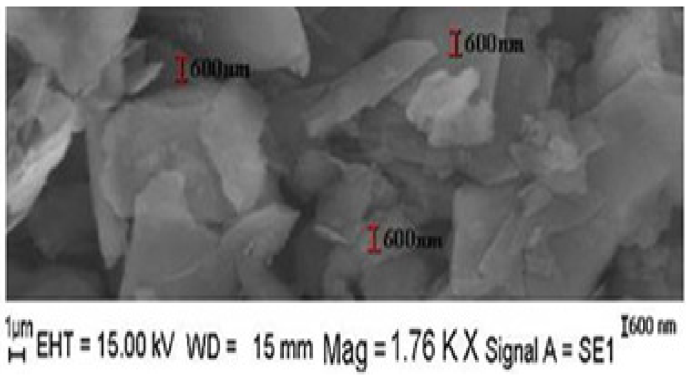

Figure-1(c)

Figure-1
SEM micrographs of the synthesized Material 1: (a) at lower resolution, (b) the higher resolution image showing aggregates, (c) the higher resolution image indicating the presence of flakes

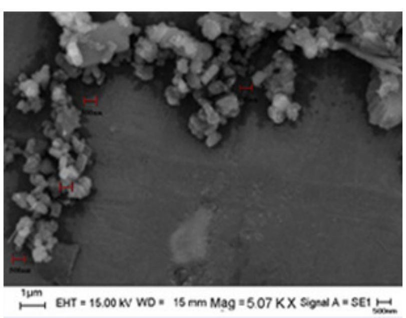

Figure-2 (a)

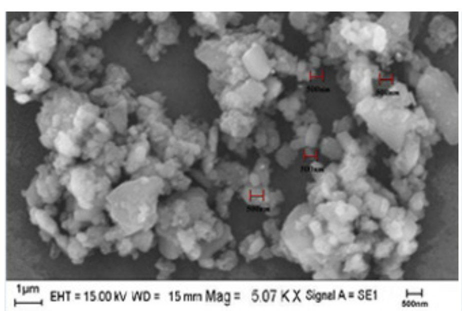

Figure-2 (b)

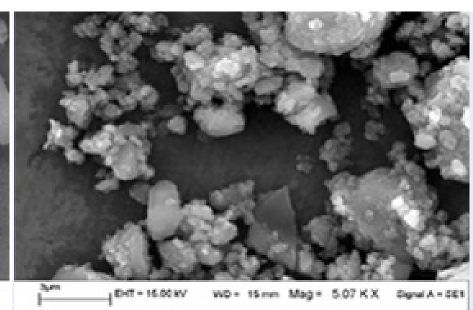

Figure-2 (c)

Figure-2
SEM micrographs of the material 2 at different resolution indicated the presence of particles

Material 2: The analysis of the SEM micrograph of the Material 2 indicates the presence of assemblage of non uniform particles. The dimensions of the particles are in the range 300-500 nm.

Elemental Analysis: The EDS (energy dispersive spectroscopy) analyses were performed to identify the elements present in the material and their relative intensities.

Material 1: The energy dispersive spectral (EDS) analysis of the Material 1 indicates the presence of high percentage of oxygen along with some contribution from magnesium and silicon. The constituents were in the approximate atomic ratio 3:1:1. This revealed that the material might be a mixed oxide. The EDS spectrum (figure-3) and the relative percentages of the elements were presented in table-1.

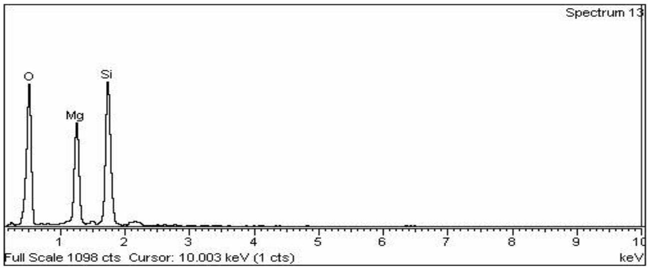

Figure-3
EDS peaks of the synthesized Material 1

Table-1
Elemental composition of the material 1

Element	Weight%	Atomic%
O	52.86	64.98
Mg	18.41	14.89
Si	28.74	20.12
Total	100	

Material 2: The EDS pattern of the synthesized Material 2 indicates the presence of carbon and oxygen as major constituents along with aluminium, sulphur and calcium as minor constituents. The percentage compositions of the material 2 are tabulated in table 2 and the EDS spectrum is displayed in the figure-4**.**

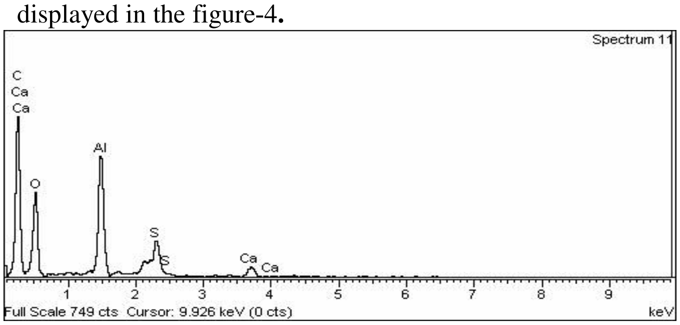

Figure-4
EDS peaks of the synthesized Material 2

Table-2
Elemental composition of the Material 2

Element	Weight%	Atomic%
C	50.82	61.58
O	33.80	30.75
Al	10.07	5.43
S	3.33	1.51
Ca	1.97	0.72
Total	**100**	

Conclusion

The synthesized materials have been obtained from natural plant based sources in an inexpensive way and the method can be scaled up and thus is a viable way for obtaining bulk material in the nano range.

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