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SILVER NANOPARTICLE SUPPORTED ON SUGAR CANE BAGASSE ACTIVATED CARBON: SYNTHESIS AND CHARACTERIZATION

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ABSTRACT

Silver nanoparticle supported on sugar cane bagasse activated carbon (Ag-SAC) was prepared by the aqueous phase borohydride reduction method under ambient conditions. The obtained Ag-SAC was characterized using Scanning Electron Microscopy (SEM), Fourier Transform Infrared Spectroscopy (FTIR), XRD and PIXE analysis. The aggregated morphology of the Ag-SAC was observed from the SEM micrograph and the FTIR spectrum shows the presence of bands at 3441.12 cm^{-1}, 1728.28 cm^{-1}, 1639.55 $cm^{-1}$and 1604.83 cm^{-1} due to O-H stretching, non-conjugated C-O, conjugated C=O in lignin and aromatic skeletal vibration in lignin. The highly crystalline nature and phase of the Ag-SAC is reflected by the XRD spectrum while the elemental composition as shown by PIXE analysis constituted majorly of Ag, Fe, Al and Si.

INTRODUCTION

Nanotechnology is defined as the understanding and control of matter at dimensions of roughly 1-100 nm, where unique physical properties make novel applications possible (Guzman et al, 2006). Data on the current use and production of NP are sparse and often conflicting. One estimate for the production of engineered nanomaterials was 2000 tons in 2004 and expected to increase to 58,000 tons in 2011-2020 (Guzman et al, 2006; Srinivasan and Hu, 1999). The aim of this study is basically to synthesize and morphologically characterize Ag-SAC composite

EXPERIMENTAL

Sample CollectionAnd Ag-SAC Preparation

Sugarcane bagasse was sourced from around the vicinity of Uyo metropolis, washed, dried and chopped into small pieces and finallypulverised.Carbonization was carried out in a limited supply of air. The dried sample was charred in the burning chamber, pyrolysed at 500 ^oC for 20 min prior to activation (Srinivasan and Hu, 1999; Lillo-Rodenas et al., 2005). The sample was mixed with 75% conc $H_3PO_4$and evaporated at 60^oC for 24 h to get a powdered activated char (Lillo-Rodenas et al., 2005). A 1 M KOH was added to the sample, stirred for 4 h washed several times with deionised water before neutralization with 0.1 M HCl (Odebunmi and Okeola, 2001). The Ag-SAC composite was prepared by dropwise addition of 0.53 M sodium borohydride as described by Shaibu *et al*. (2014).

Instrumentation

The SEM of Ag-SAC composite was viewed under a FEI^{TM}scanning electron microscope (Nova Nano SEM 230). A 1.7MV tandem pelletron accelerator (model 5SDH) was used for elements analysis while Shimadzu (8400s) was used for FTIR analysis.

RESULTS AND DISCUSSION

Scanning Electron Microscopy (SEM)

The SEM image of the synthesized Ag-SAC presented in Figure 1 showed significant agglomeration due to the large surface area and ambient synthesis condition but tend to disperse

in solution (Li *et al*., 2006) the surface of Ag-SAC is heterogeneous and characterized by numerous uneven pores.

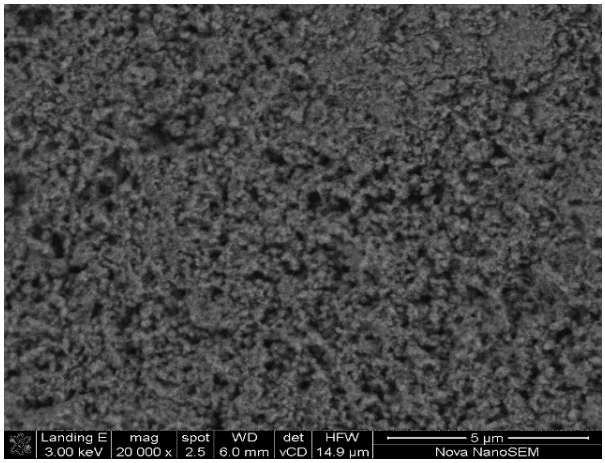

Figure 1: SEM image of Ag-SAC

Particle Induced X-Ray Emission (PIXE)

The elements present in Ag-SACrange from Si to Zn as shown in Table 1.0. The concentration of Ag is highest due to the precursor used for the synthesis of the composite while that of other elements is comparatively reduced as they are contributions from SAC.

Table 1: Concentration of elements in Ag-SAC by PIXE analysis

Elements	Ag	Al	Si	K	Ca	Ti	Cr	Fe	Zn
Concentration(mg/g)	1584.7	85.7	76.6	26.0	35.0	3.9	28.8	91.0	24.8

Fourier Transform Infra Red Spectroscopy (FTIR)

The adsorption peak at 3417.98 cm^{-1} as shown in Fig 2 indicates the existence of free hydroxyl groups in Ag-SAC.

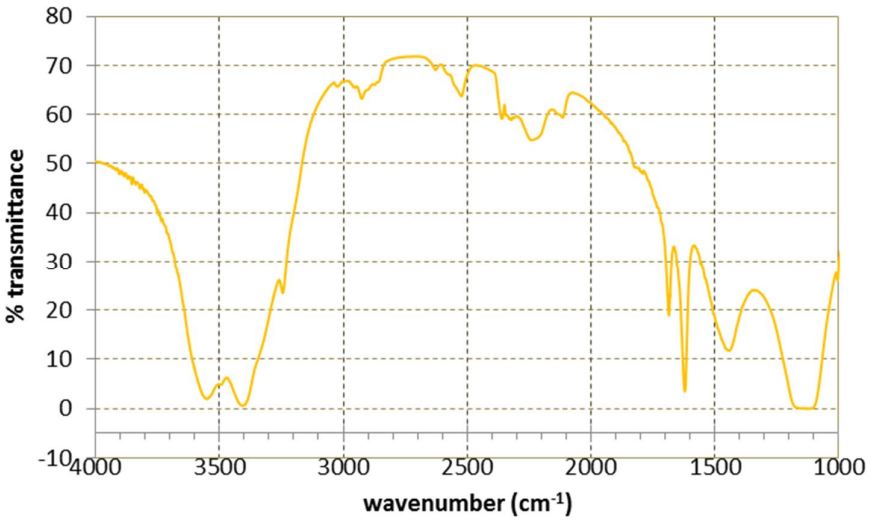

Figure 2: FTIR of Ag-SAC

Bands at the range 1653.05-1689.70 cm^{-1} corresponds to the C=O stretching that was attributed to the hemicelluloses and lignin aromatic group (Odebunmi and Okeola, 2001). The C=O stretching vibrations between 1743.71-1737 cm^{-1} is indicative of ester functional group while those at 1456.3-1373.36 cm^{-1} indicate the existence of CH_2 and CH_3 groups. These peaks at1240.27 and1192.05 cm^{-1} correspond to CHOH stretching and Si-O-Si stretching respectively.

X-Ray Diffraction of Ag-SAC

The crystalline nature of Ag-SAC was confirmed by the analysis of XRD pattern as shown in Figure 3 and it showed some distinct diffraction peaks at 37.51^0, 35.33^0, 57.33^0 , and 59.53^0 corresponding to lattice plane value indexed at (111), (200), (220) and (311) planes of face centered cubic (FCC) silver with a lattice parameter of a = 4.08 Å which were in good agreement with reference of FCC structure from joint committee of powder diffraction standard (JCPDS) Card No-087-0720.

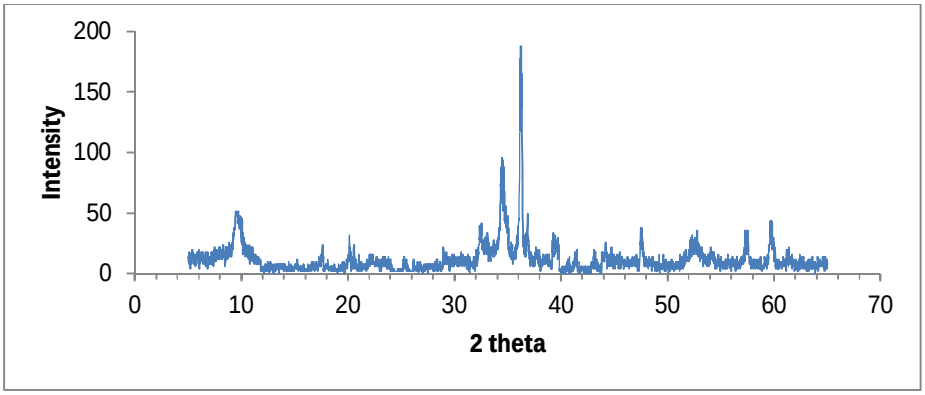

Figure 3:: XRD of Ag-SAC

CONCLUSION

The elemental determination showed that the level of inorganic materials present in Ag-SAC is a function of the precursors (Ag and SAC) that make up the composite. The presence of predominantly OH functional group, pores on the surface of the composite shows its suitability for application in adsorption.

REFERENCES

Guzman, K.A.D., Taylor, M.R., Banfield, J.F. (2006). Environmental risks of nanotechnology: national nanotechnology initiative funding 2000—2004. *Environ Sci Technol*., 40:1401—1407

Srinivasan, M.P. Hu, Z. (1999). Preparation of high surface-area activated carbon from coconut shell, Microporous and Mesoporous. *Materials*, 27, 11-18.

Lillo-Rodenas, M.A., Cazorla-Amoros, D., Linares-Solono, A. (2005). Behavior of Activated carbons with different pore size distribution and surface oxygen groups for Benzene and Toluene Adsorption at low concentration carbon. *Afr. J. biotechnology*, 43; 1758-1767.

Odebunmi, E.O. And Okeola, O.F. (2001). Preparation and characterisation of activated carbon from waste material.*J. of Chem. Soc.of Nigeria*, 26(2): 149-155.

Shaibu, S. E., Adekola, F. A., Adegoke, H. I., &Ayanda, O. S. (2014). A comparative study of the adsorption of methylene blue onto synthesized nanoscale zero-valent iron-bamboo and manganese-bamboo composites.*Materials*, 7(6), 4493-4507.

Li, L., Fan, M., Brown, R.C., van Leeuwen, L., (2006). Synthesis, Properties, and Environmental Applications of Nanoscale Iron-Based Materials: A Review.*Critical Reviews in Environmental Science and Technology* 36; 405-431.