Green Synthesis of Molybdenum Trioxide Nanoparticles Using Syzygium Aromaticum Flower Buds Extract.

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Abstract--- Molybdenum trioxide (MoO_3) nanoparticles were synthesized in an eco-friendly and facile manner using syzygium aromaticum flower buds extract. The nanoparticles have undergone necessary characterizations like XRD, TEM, FTIR spectroscopy and UV spectroscopy, to confirm the obtained product, to study the size and morphology, functional groups and absorption spectra respectively.

I. INTRODUCTION

Green chemistry is mainly based on the principle that, it is appropriate to prevent waste than to clean up or treat after it is formed. The green synthesis incorporates all the materials used in the process into the final product. It does produce by products at times but which generally possess little or no toxicity to human health or environment.

Molybdenum trioxide is a compound of molybdenum. Its production is largest compared to any other compound of molybdenum. Molybdenum trioxide nanoparticles unlike zinc oxide nanoparticles or cerium oxide nanoparticles have been sparsely studied. MoO_3 nanoparticles are an excellent oxidation catalyst and are of interest in electrochemical devices like gas sensing and displays.

Syzygium aromaticum is a plant that is native to Maluku islands in Indonesia. These plants produce flower buds that have a very strong aroma. These buds are dried and used as spice. The common name for the syzgium aromaticum flower buds is cloves. The syzygium aromaticum flower buds, apart from being used as spice also exhibits significant anti-microbial activity. They are also used as an efficient insect repellent. Their extract is used for other pharmaceutical applications also. The important oil constituents of the flower buds include acetyl eugenol, vanillin, methyl salicylate, kaempferol, eugenitin and oleanolic acid.

II. MATERIALS AND EXPERIMENT PROCEDURES

A. Materials used

Ammonium heptamolybdate was purchased from MERCK chemicals and commercially available cloves were used. Double distilled water was used throughout the process.

B. Preparation of clove extract

20 dry flower buds of syzygium aromaticum plant were taken and washed with distilled water to remove any dust particles on the cloves. These buds were seethed in 100ml of distilled water at 60°C for 90min. The solution was filtered using whatman no.1 filter paper and stored under refrigerated conditions.

C. Experiment procedure

A lucid solution of ammonium heptamolybdate was formed by dissolving 0.2mM of ammonium heptamolybdate in 100ml of distilled water. 10ml of the extract was added drop by drop to the ammonium heptamolybdate solution under constant stirring. The solution was stirred for 15min and then heated in a hot air oven at 60°C till the supernant liquid got evaporated. The obtained product was then powdered and calcinated at 700°C for 3hrs in a muffle furnace.

III. RESULTS AND DISCUSSIONS

A. X-ray diffractometer

The XRD analysis was done to confirm that the obtained product was molybdenum trioxide. The XRD was done by Cu K-alpha radiation (1.54 A°). The structure of MoO_3 nanoparticles synthesized had an orthorhombic phase. The XRD peaks were observed at 12.8°, 23.5°, 25.7°, 27.3°, 29.8°, 33.6°, 39.1°, 49.3°, 58.9° and 64.5° The product was confirmed to be MoO_3 by comparing the peak values with JCPDS software, the peak values matched with JCPDS card no.35-0609.

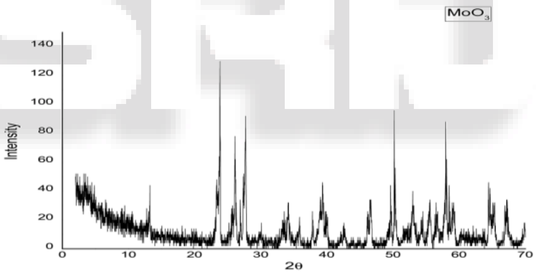
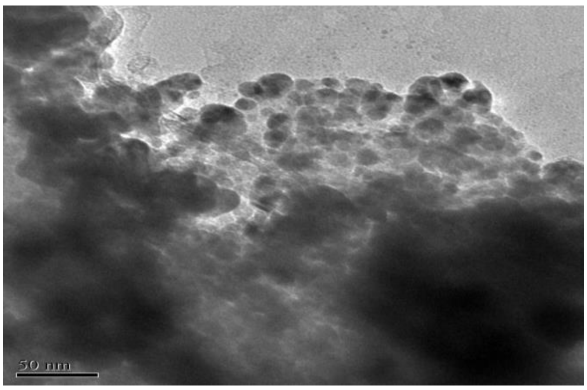


Fig. 1: XRD plot of MoO_3 nanoparticles

B. Transmission electron microscope

The morphology study was done by conducting the TEM analysis. The particles were observed to be almost spherical in shape. The size of the nanoparticles was also calculated using the TEM micrographs and the size distribution was found to be pretty uniform. The average size of the nanoparticles was observed to be about 19.47nm.



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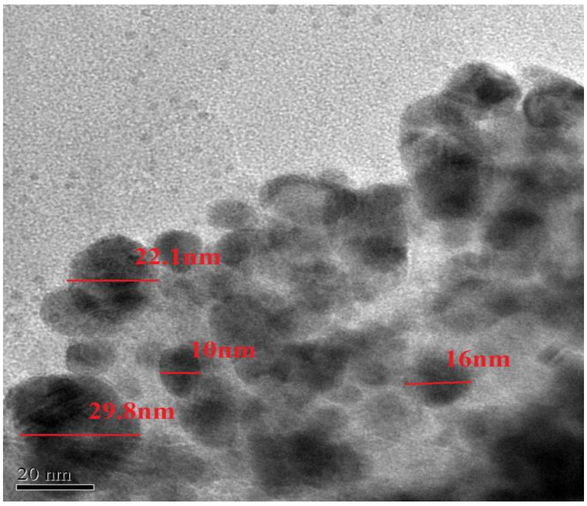

Fig. 2: FIG. 3: TEM micrographs of MoO_3 nanoparticles

C. *Fourier transform infrared spectroscopy*

The FTIR spectroscopy was done to study the functional groups present in the compound.

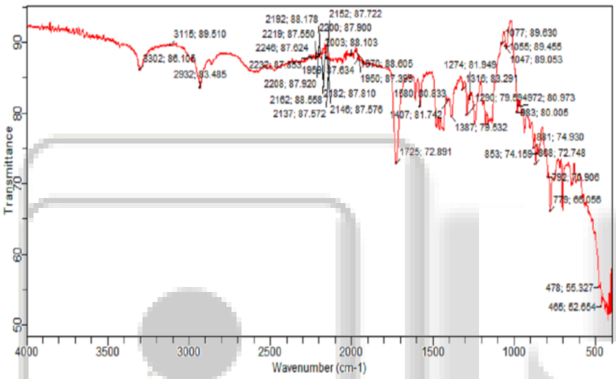

FIG 4. FTIR graph of MoO_3 nanoparticles

The FTIR peaks were observed at 779.6, 853.7, 1327.7, 1725.71, 2932.93 and 3302.2, which correspond to bonds (functional groups), C-H (aromatics), N-H(amines), C-N (aromatic amines), C=O (unsaturated esters), C-H (alkanes) and =C-H (alkenes) respectively. The N-H stretch was observed as a result of using ammonium heptamolybdate as precursor, the other bonds were observed as a result of using syzygium aromaticum flower buds extract for synthesis which consists of acetyl eugenol, which is responsible for their characteristic aroma.

D. *Ultraviolet-Visible spectroscopy*

The absorbance spectrum of green synthesized MoO_3 nanoparticles was analyzed by UV spectroscopy. The absorbance peak was observed at 252nm, which falls under the ultraviolet region. The ultraviolet region is further sub-

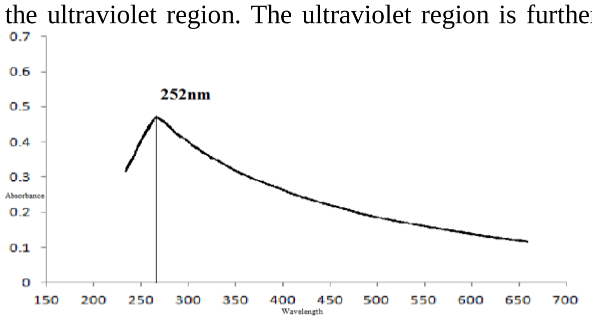

Fig. 5: UV spectroscopy graph of MoO_3 nanoparticles

categorized, of which 200-280nm wavelength are called short wave ultraviolet rays. The short wave ultraviolet rays are represented as UV-C. So, this indicates that MoO_3 nanoparticles absorb the UV-C rays effectively.

IV. CONCLUSION

MoO_3 nanoparticles were green synthesized using syzgium aromaticum flower buds extract. The product was confirmed to be MoO_3 by comparing the XRD peak values with JCPDS software. The MoO_3 nanoparticles were subjected to TEM analysis to study the size and morphology. The size of the nanoparticles was found to be 19.47nm and the particles were observed to be spherical in shape. The green synthesis was efficient in controlling the size of MoO_3 nanoparticles.

V. ACKNOWLEDGMENT

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