

Details of chemicals, materials and equipments

In this chapter, details of chemicals and list of materials used for the synthesis of nanomaterials and details of instruments that used for the characterization of materials were discussed.

2.1. Materials

All the chemicals used were of analytical grade. Solvents used were of spectroscopic grade. Precursor substrate such as oil was procured commercially. List of other plant based precursors are include in **Table 2.1** while details are described under ‘Materials’ section of the respective chapters.

2.2. Details of Instruments

2.2.1. UV-visible study

UV-visible spectra were recorded on a Shimadzu 1601 PC UV-visible spectrophotometer.

2.2.2. FT-IR study

FT-IR spectrawere recorded on aPerkin Elmer spectrum 2 spectrophotometer using KBr pellets.

2.2.3. Raman study

Raman Spectra were recorded on a RenishawRM1000B LRM using a 514.5 nm ($E_{\text{laser}} = 2.41 \text{ eV}$) Ar^+ laser excitation source.

2.2.4. Powder X-ray diffraction study

Powder X-ray diffraction (XRD) measurements were carried out on a Philips X'PERT powder X-ray diffractometer with $\text{Cu-K}\alpha$ radiation ($\lambda=1.54056 \text{ \AA}$) with a scan speed $2^\circ/\text{min}$ at room temperature and on a Bruker AXS D8-Advance powder X-ray diffractometer with $\text{Cu-K}\alpha$ radiation ($\lambda=1.5418\text{\AA}$) with a scan speed $2^\circ/\text{min}$ at room temperature.

2.2.5. Scanning electron microscopy

Scanning electron microscopy (SEM) images were obtained on a JEOL, JSM-6360 equipment, LEO, 1430vpequipment and on Quanta 150 equipment with an accelerating voltage of 1KV-30KV.

2.2.6. Transmission electron microscopy

Transmission electron microscopy (TEM) images were obtained on a JEOL, 9JSM-100CX equipment with an accelerating voltage of 60-200 KV. The sample powders were dispersed in ethanol, under sonication and TEM grids were prepared using a few of the dispersion followed by drying in air.

2.2.7. Energy dispersive X-ray study

Energy dispersive X-ray (EDS) pattern was recorded on JEOL, JED2300 SEM equipment, JEOL, 9JSM-100CX TEM equipment and Quanta 150 SEM equipment.

2.2.8. Tap density

The tap density was measured by mechanically tapping the synthesized material in a graduated vessel. The initial powder volume or mass is taken and then the vessel is mechanically tapped, and volume or mass readings are taken until no further volume or mass change is observed. The mechanical tapping is achieved by raising the cylinder or vessel and allowing it to drop, under its own mass. The volume of the graduated vessel was calibrated with distilled water.

2.2.9. Capacitance study

The capacitance measurements were carried out using cyclic voltammetry and galvanostatic charge/discharge method using a Potentiostat/Galvanostat (Gamry instruments, Reference 3000, Version 5.61) system.

2.2.10. Antioxidant activity

The antioxidant property was monitored by diphenyl picrylhydrazyl(DPPH) scavenging method. UV-visible spectrometer (Shimadzu 1800 PC) was used to determine the variation in DPPH concentrations at 517nm. A modified DPPH method was used to determine antioxidant activities of the synthesized material because materials are insoluble in methanol. The free radical scavenging assay was calculated by sonicating the mixture of synthesized materials (2, 4, 6, 8 and 15mg) and DPPH (3 ml, 100 μ M) in methanol. After centrifugation, absorbance is measured at 517 nm at an interval of 15, 30, 45 and 60 minutes.

2.2.11. Antimicrobial activity

The disc diffusion method was used to determine the inhibition zones. Sterile molten Mueller-Hinton Agar cooled to 45°C was inoculated with different organisms. The inoculums used were the young cultures and the inoculum size was standardized in such a way that each mL contains 10⁸ cells. Using an aseptic technique, the inoculum was uniformly inoculated over the molten agar with sterile cotton swabs. A Whatman No 2 filter paper disc of 6 mm diameter containing 200 μ L/disc of sample was placed over the inoculated medium. The plates were allowed to remain at room temperature for two hours. Then the plates were incubated at 37°C for 24 hours. The zone of inhibition was measured using a Zone Reader scale.

2.2.12. Photocatalytic activity

Photocatalytic activity of the material was studied by methylene blue (MB) degradation in visible light using 18 Watt CFL bulb in a closed chamber. The degradation efficiency was monitored using a Spectrophotometer, Systronics106.

2.2.13. Photoluminescence study

Photoluminescence spectrum was recorded on a Shimadzu RF-5301 PC spectrofluorophotometer at room temperature.

Table 2.1 Precursors used for the nanomaterials synthesis

| Sl. No. | Precursors |
|---------|---|
| 1. | Turpentine oil |
| 2. | Sesame oil |
| 3. | Soybean oil |
| 4. | Sun flower oil |
| 5. | Refined Mustard oil |
| 6. | Palmolein oil |
| 7. | <i>Ghee</i> (clarified butter from cow's milk) |
| 8. | D-fructose |
| 9. | 1-Butanol |
| 10. | Vinyl alcohol |
| 11. | Krishnachura or Gulmohar (<i>Delonixregia</i>) seeds |
| 12. | Krishnachura or Gulmohar (<i>Delonixregia</i>) leaves |
| 13. | Bean (<i>Phaseolus</i> sp.) seeds |
| 14. | Castor (<i>Ricinuscommunis</i>) seeds |
| 15. | Castor (<i>Ricinuscommunis</i>) seed coats |
| 16. | Lai (<i>Brassica juncea</i>) seeds |
| 17. | Denga (<i>Amaranthus spinosus</i>) seeds |
| 18. | Sandal wood (<i>Santalum</i> sp.) seeds |
| 19. | Kanchan (<i>Bauhinia acuminata</i>) seeds |
| 20. | Tishi(<i>Linum</i> usitatissimun) seeds |
| 21. | Mahogany (<i>Swieteniamehogoni</i>) seed coats |
| 22. | <i>Crassocephalumcrepidioides</i> seed hairs |
| 23. | Taal or Palmyra (<i>Borassusflabellier</i>) fibres |
| 24. | Taal or Palmyra (<i>Borassusflabellier</i>) seeds |
| 25. | Bladygrass (<i>Imperatacylindrica</i>) inflorescences |
| 26. | Purol(<i>Luffacylindrica</i>) fibres |
| 27. | <i>Pajanelialongifolia</i> seeds |
| 28. | Daisy (<i>Tridaxprocumbens</i>) seed hairs |
| 29. | <i>Eulaliafastigiata</i> inflorescences |
| 30. | Ishabgul orPsyllium (<i>Plantago</i> sp.) seed husk |

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31. Papaya (*Carica papaya*) stems fibre
 32. *Oroxylum indicum* seeds
 33. Papery bracts of Paper flower (*Bougainvillea spectabilis*)
 34. Bontula (*Bombax insigne*)
 35. Thunga or Takpalong (*Spinacia oleracea*) seed coats
 36. Betel nut (*Areca catechu*) fibres
 37. Blue-green alga, *Scytonema guyanense*
 38. Green alga, *Trentepohlia aurea*
 39. Green alga, *Spirogyra neglecta*
 40. Plant charcoal
 41. Waste bond paper
 42. *Dalbergia sissoo* leaves
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