KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University)
(Established Under Section 3 of UGC Act 1956)
COIMBATORE-21
(For the candidates admitted from 2016 onwards)

DEPARTMENT OF PHYSICS

SUBJECT: NANO MATERIALS AND APPLICATIONS (PRACTICAL)
SEMESTER: VI
SUB.CODE: 17PHU611A **CLASS: III B.Sc PHYSICS**

Any 7 experiments

1. Synthesis of metal nanoparticles by chemical route.
2. Synthesis of semiconductor nanoparticles.
3. Surface Plasmon study of metal nanoparticles by UV-Visible spectrophotometer.
4. XRD pattern of nanomaterials and estimation of particle size.
5. To study the effect of size on color of nanomaterials.
6. To prepare composite of CNTs with other materials.
7. Growth of quantum dots by thermal evaporation.
8. Prepare a disc of ceramic of a compound using ball milling, pressing and sintering, and study its XRD.
9. Fabricate a thin film of nanoparticles by spin coating (or chemical route) and study transmittance spectra in UV-Visible region.
10. Prepare a thin film capacitor and measure capacitance as a function of temperature or frequency.
11. Fabricate a PN diode by diffusing Al over the surface of N-type Si and study its V-I characteristic.

Reference Books:

1. C.P.Poole, Jr. Frank J.Owens, Introduction to Nanotechnology (Wiley India Pvt. Ltd.). S.K. Kulkarni,
2. Nanotechnology: Principles & Practices (Capital Publishing Company). K.K. Chattopadhyay and A.N. Banerjee,
3. Introduction to Nanoscience & Technology (PHI Learning Private Limited).
4. Richard Booker, Earl Boysen, Nanotechnology (John Wiley and Sons).

SYNTHESIS OF SILVER NANOPARTICLES

Expt No:

Date:

Aim: To synthesize metal nanoparticles of silver.

Chemicals

1. Silver nitrate (AgNO3) for silver particles
2. Trisodium citrate (C6H5O7Na3)
3. Double distilled water

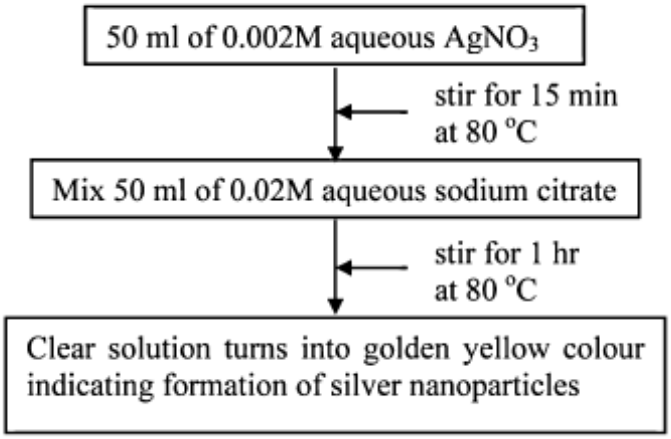
14.2.2 Equipments

1. Round bottom flask
2. Magnetic stirrer cum heater
3. Optical absorption spectrometer (_250–700 nm)

Synthesis Procedure

Procedures to synthesis silver nanoparticles are given in the flow chart form. Synthesis can be carried out using the glass apparatus or set up as shown in Fig.

Silver nanoparticles



Results

The magenta red and yellow colors for silver solutions respectively indicate the formation of nanoparticles. Changing the concentrations, reaction time, temperature etc. one can obtain different shapes/sizes of the particles. This changes the solution color or shades. There is large literature on these aspects. Typical photograph of gold and silver particles obtained using above procedure.

Silver

Expt No:

Date:

SYNTHESIS OF Fe_2O_3 NANOPARTICLES

Aim: To synthesize iron oxide particles of different shapes.

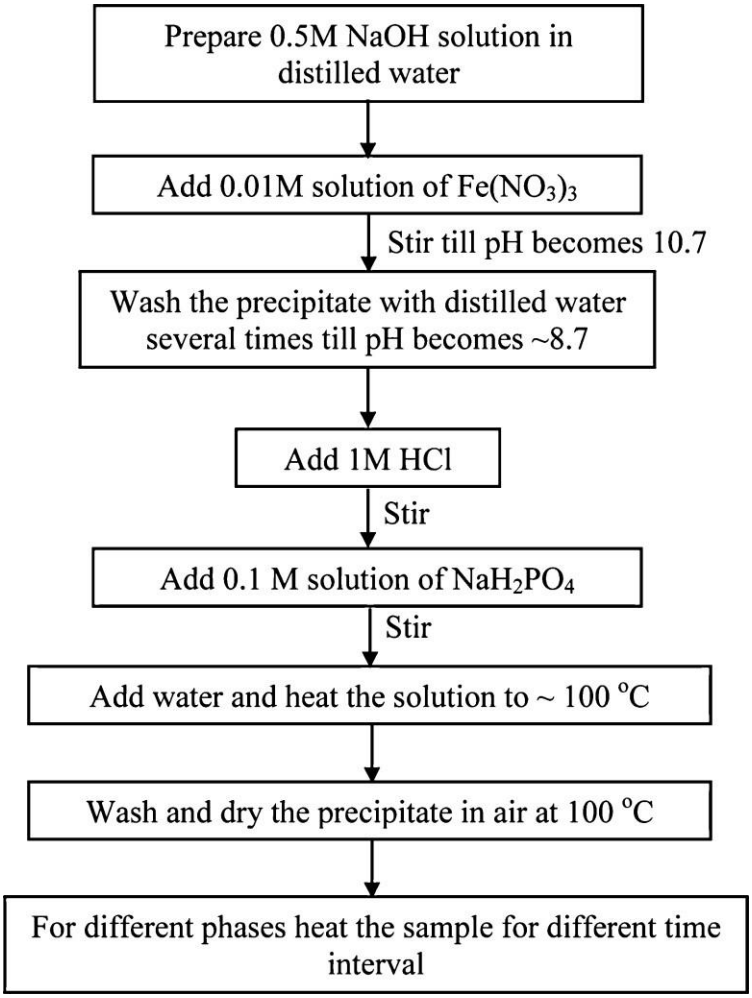
Chemicals

1. Sodium hydroxide (NaOH)
2. Iron chloride (FeCl3)
3. Sodium hexametaphosphate (NaH2PO4)
4. Double distilled water

Equipments

1. Round bottom flask
2. Magnetic stirrer cum heater

Synthesis Procedure



Results

The Fe2O3 nanoparticles were synthesized successfully.

Expt No:

Date:

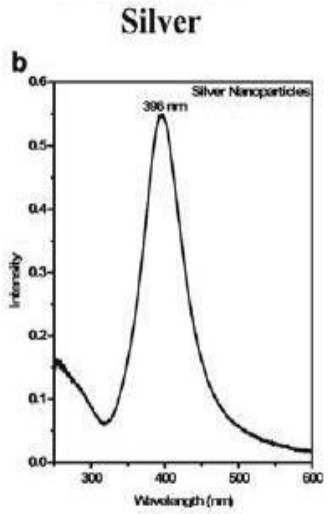
OPTICAL ANALYSIS OF SILVER NANOPARTICLES

Aim: To study the optical properties of Ag nano-particles using UV-Vis absorption spectrum.

Chemicals

1. Chloro auric acid (HAuCl4) for gold particles
2. Silver nitrate (AgNO3) for silver particles
3. Trisodium citrate (C6H5O7Na3)
4. Double distilled water

Synthesis Procedure



Silver nanoparticles

50 ml of 0.002M aqueous $AgNO_3$

↓ stir for 15 min at 80 °C

Mix 50 ml of 0.02M aqueous sodium citrate

↓ stir for 1 hr at 80 °C

Clear solution turns into golden yellow colour indicating formation of silver nanoparticles

Results

Optical absorption spectra can be recorded using a simple absorption spectrometer. Figure illustrates typical spectra obtained for the synthesis described here. It can be seen that peak for silver appears at approximately 396 nm.

Expt No:

Date:

XRD pattern of Nanomaterials

Aim:

To determine the lattice parameter and grain size of nanomaterials by XRD pattern.

Formula

$$a=d\sqrt{(h^2+k^2+l^2)}$$

$$D= 0.9\lambda/\beta\cos\theta$$

Where

a- lattice parameter (A)

d-grain size (nm)

h,k,l – miller indices

λ – wavelength of copper

β – full width half maximum

Tabulation

Lattice Parameter

2θ	h	k	L	d spacing	β

Grain Size

2 θ	θ	β	β	θ	cos θ	β cos θ	D= 0.9λ/βcosθ

Result

The lattice parameter and grain size of the given material is calculated as _____

Expt. No.

Date:

SILVER NANOPARTICLES BY GREEN SYNTHESIS METHOD

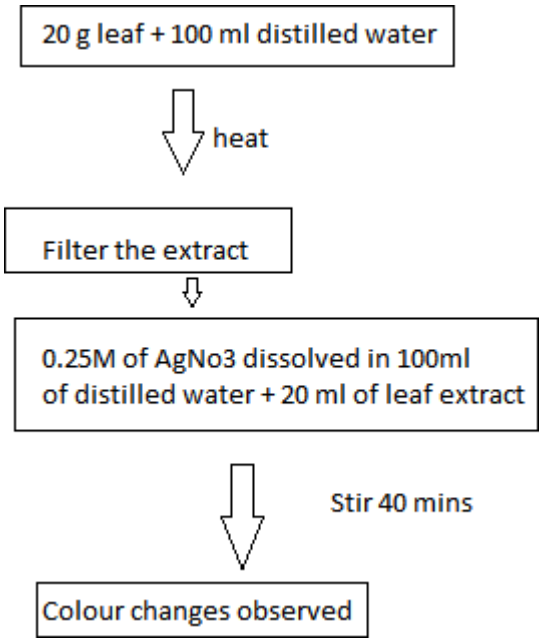
Aim

To synthesis silver nanoparticles by Green synthesis method.

Chemicals and Equipment

Green leaf, Distilled water, Silver nitrate, Beaker, Magnetic Stirrer and Heater.

Synthesis Procedure



Result

Silver nanoparticles have been prepared by green synthesis method and the colour changes have been observed.

Expt No:

Date:

PREPARATION OF $FeCl_3$ THIN FILM

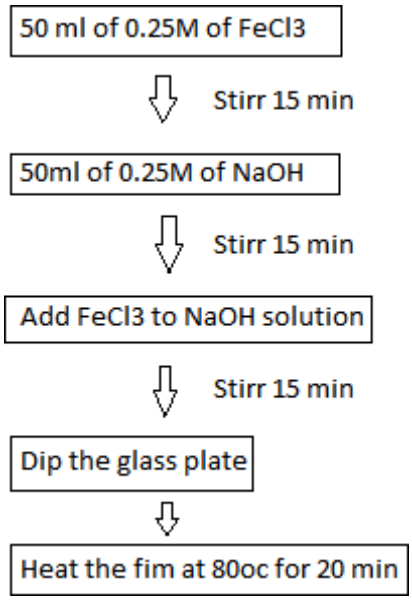
Aim

To prepare a $FeCl_3$ thin film.

Chemicals and Equipment

$FeCl_3$, NaOH, Beaker, Magnetic Stirrer, Distilled water, Glass Plate

Synthesis Procedure



Result

$FeCl_3$ thin film prepared in glass plate.