

Format for uploading details of completed projects

1. Project details

- a. Title: Development of metal nanocomposites for the enhancement of efficiency of solar cell**
- b. Institute: NIT, Agartala, Tripura**

2. Aim / Objectives:

1. To synthesis desirable size and bulk amount of low cost metal nanoparticles, having suitable band gap energy, using our own indigenous processes, which can enhance the power conversion efficiencies (Ag/ Zn/ Al/ Cd/ graphene).
2. Graphene will be prepared from heat-treatment of easily available chemicals or agrowastes/fruitwastes at relatively low temperatures and at normal atmospheric conditions. This synthesis technique will be environmentally friendly and also economic to develop the nanocomposites used for increasing the efficiency of solar cells.
3. To prepare and optimize various combinations of nano-composite materials using metal / graphene / graphene oxide/ graphene oxide derivatives/ conducting polymer/ CNT/ MWCNT/ and carry out the study of current-voltage (I-V) properties.
4. To carry out the design and development of photovoltaic device to achieve the respectable conversion efficiencies of around or above 10%.

3. Executive Summary (One page):

In this project, synthesis of low cost metal nanoparticles having suitable band gap energy (Ag/ Zn/ Al/ Cd/ graphene and its derivatives) in bulk amount (gms) was carried out using green and cost-effective processes at the temperature range of 50 to 150 °C under normal atmospheric conditions using water or alcohol as solvents, thereby avoiding the harsh chemicals. Selection and preparation of these potential metal nanoparticles was done on the basis of exhibiting high scattering efficiency and low absorption (i.e. high radiative efficiency) at near-infrared wavelengths. Moreover, graphene was chemically synthesized by heating easily available chemicals like carbohydrates and organic acids, etc at relatively low temperature of 100-200 °C at normal atmospheric conditions and pyrolysis of agrowastes/

fruit wastes in the muffle furnace, bypassing the costly CVD technique and graphite powder (produced at ≥ 2500 °C), which are mainly used to produce graphene, now a days. This synthesis technique was environmentally friendly and also economic to develop the nanocomposites used for increasing the efficiency of solar cells. The structure and the surface morphology of metal / carbon nano-structured materials was carried out by different techniques such as DLS, SEM, HRTEM, AFM, XRD analysis, etc.

Thin films of suitable blends of nanocomposite materials using semi-conducting polymers with carbon nanotubes / metal nanoparticles like ZnO, CdS, TiO₂, Ag, Al, etc/ graphene was prepared under optimized atmospheric conditions. Thin film nanocomposites was characterized by UV-Vis and FTIR spectroscopy, SEM, TEM, AFM XRD, EDX.,etc. Electrical and optical properties of the resultant nanocomposites was studied in detail. In the design and fabrication of a cell, our prime aim was to maintain the photoactive region, which can absorb light in the range of about 400 nm to 1450 nm. Current voltage measurements of the blended nanocomposites showed the efficiency of 8-12%.

4. Scope for further work

The product needs field test for commercialization of the metal-graphene based solar cells.

5. Benefits visualized

Graphene's exceptional electrical conductivity and high carrier mobility improved the charge collection efficiency, boosting overall power conversion efficiency (PCE). It is an effective replacement for scarce materials like indium in transparent electrodes. Graphene is extremely strong yet lightweight, making it ideal for flexible, bendable solar panels for future.