BEST PRACTICES

Of

DEPARTMENT OF PHYSICS

Best practices of Department of Physics in line with SANKALP

Best Practices of the Department of Physics, Union Christian College, Aluva, under the theme 'SANGALP' - **Sustainable Action for Nature,Knowledge and Accountable Life Practices**

Best practices of Department of Physics in line with SANKALP

Addressing environmental issues and promoting sustainable practices for the well-being of our ecosystems for future generations, the Department of Physics has identified research areas in

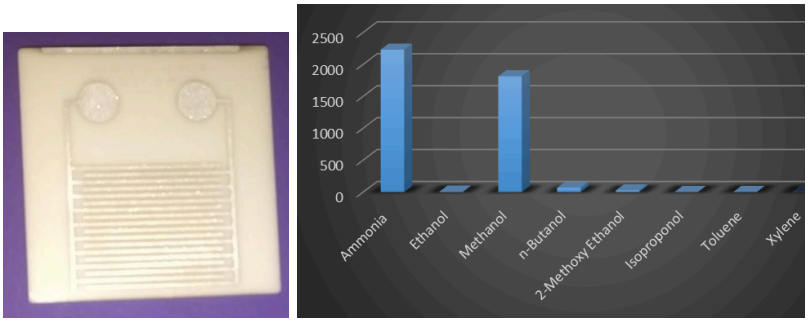
- Renewable energy like solar cell fabrications addressing global energy challenges and transition towards a more sustainable energy future.
- Gas Sensors- Detecting harmful gases by fabricating gas sensors (ammonia, LPG etc)
- Waste water treatment - Photocatalytic degradation of toxic industrial dyes
- Biochar Assisted waste water treatment: Use of invasive plants
- Biomedical application- Development of non toxic materials for sustainable biomedical applications.
- Lab to society

- **Renewable energy**

Understanding and improving the efficiency of solar cells is a key point of research in the department. Thin film solar cell fabrication , Dye sensitised solar cells(DSSC) , lead free perovskite materials for stable and environmental friendly solar cells are widely investigated in various national and state funded projects.

- **Gas Sensors**

Departments has initiated works on fabrication of gas sensors for detecting harmful gases like methanol, CO2, carbon monoxide, LPG , ammonia etc using environmental friendly nanostructures which finds application in automobile industry, households and other industries where toxic gases are involved. The sensors are fabricated and studied to understand the limit of detection and their selectivity.

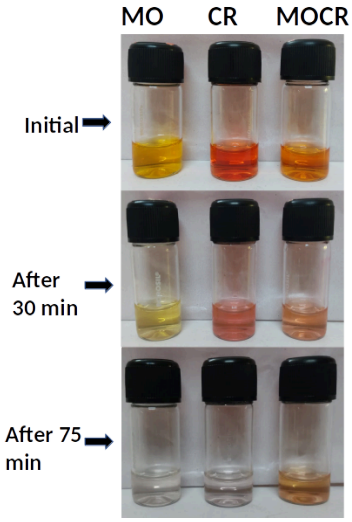


Sensors fabricated in our department for ammonia and methanol sensing.

- Wastewater treatment -

Photocatalysis is one of the thrust areas of research in the Department of Physics. Environmental friendly materials are used in this area for effective treatment of industrial effluents from dye which are a major cause of water pollution. Photocatalysis is usually carried out under sunlight. Methyelne blue, congo red, malachite green etc are degraded under laboratory conditions . As an extension activity, dyes are collected from a nearby boutique and a prototype set for Photocatalystic degradation of these dyes are made. Using a lead free environmentally friendly materials developed at the Department of Physics a complete degradation of these dyes could be achieved using direct sunlight.

Deep Blue Dark Maroon After degradation



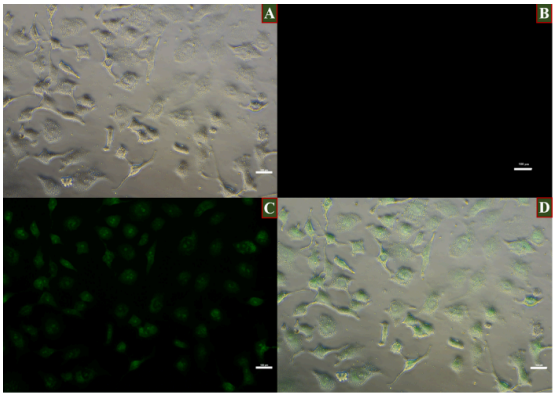
Photocatalytic degradation of azo dyes Methyl Orange (MO)- 96%, Congo Red (CR) -97.6% and their mixture MOCR- 64% using electrochemically anodized ZnO nanostructures.

- **Biochar Assisted waste water treatment:**

Biochar is a carbon-rich biomaterial derived from biomass by pyrolysis. Due to their adsorption ability, biochars have been used in the removal of heavy metals, pesticides, herbicides, etc from water and soil. Biochar could be formed from diverse sources of biomass, yet the use of invasive plant species for the preparation of biochar is advantageous as it turns an environmental problem into a valuable resource. After dye degradation, the photocatalyst and other inorganic pollutants are removed from the solution through the process of adsorption by biochar prepared from invasive plant species.

- **Biomedical application- Development of non toxic materials for sustainable biomedical applications.**

We report the successful preparation of intense blue emitting monoclinic Y_2O_3 quantum dots surface modified by biotin and they are found to be nontoxic to both normal and cancer cells. This work also demonstrated the applicability of the material in cancer cell detection through live cell imaging experiments performed on human breast cancer cell lines for prolonged incubation time.



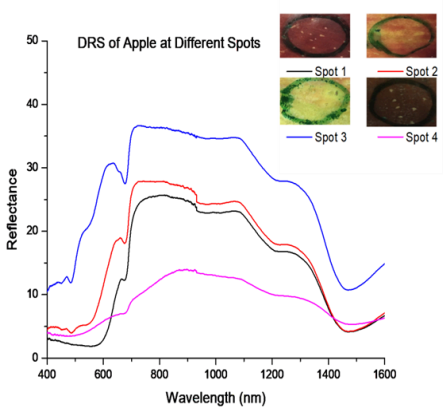
Live Cell Imaging of MCF 7 Cells Using Biotin Modified Yttrium Oxide Quantum Dots. (A) Bright field image of MCF 7 cells, (B) Control (Fluorescence image of cells without sample), (C) Fluorescence emission from cells with biotin modified yttria and (D) Merge of both (A) and (C). The scale bar given is 100 µm.

- **Lab to Society**

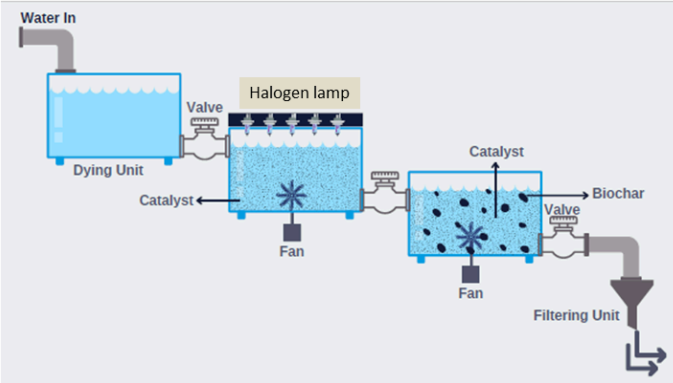
Research activities have facilitated the fabrication of prototype set ups eco friendly for small scale applications in the above fields.

Non-Destructive and Rapid Method for Quality Assurance of Fruits and Vegetables using Diffuse Reflectance Spectroscopy

- Design and calibrate a system to ensure the quality of fruits and vegetables using rapid and non-destructive method.
- To develop a normative database of using different samples of specific fruits/vegetables for quality assurance.
- Detect the presence of pesticides in fruits and vegetables



Prototype set up developed for the local textile industry for treatment of their waste water for edible purposes.



Outcome of sustainable research

The primary outcome of the work is research publication in high impact journals and patents. The students get the opportunity to present their results in conferences to reach out to the

community in large. The department gets support from national and state governments in the form of core research grants. The department could mobilize more than 2 crore from these works during the last five years.

The outcome of work is the communication of the progress of sustainable and eco friendly ideas visioned in these projects to the scientific community, especially research students . This is mitigated to locality through facilitating consultancy via prototypes and data analysis. Awareness programs through seminars and workshops are regularly conducted. These projects provide a comprehensive framework for implementing sustainable initiatives and fostering environmental stewardship at the community level. The project aims to empower student communities to embrace sustainable lifestyles and contribute to the conservation of nature and biodiversity.