Name of Facility or centre	Centre of Research Excellence
Academic year of establishment	2022-23
School Name	P P Savani University
Incharge name	Dr. Vinaydeep Punetha

Introduction

The Centre of Excellence for Research stands at the forefront of innovation in the field of nanomaterials and advanced polymer synthesis, establishing itself as a beacon for cutting-edge scientific exploration and application. Equipped with state-of-the-art facilities, the centre is dedicated to the development of novel nanomaterials and the functionalization of these materials for a broad spectrum of applications, with a particular emphasis on remote actuation technologies. The research is primarily focused on tailoring carbon-based nanomaterials as well their doped counterparts and checking their applicability for enhancing the shape memory behaviour of certain smart polymers. Through utilizing advanced tools and specialized knowledge, the research centre leads the way in exploring the new possibilities in material science. This exploration holds great promise for advancements that will impact various industries significantly. It serves as a hub for collaboration, attracting top-tier researchers and fostering interdisciplinary exchange.

Vision and Impact

The Centre of Excellence for Research envisions a future where materials science and nanotechnology drive progress across multiple industries, improving the quality of life and advancing technological frontiers. By focusing on the synthesis of advanced materials and their application in ground breaking technologies, the centre aims to contribute significantly to the fields of materials science, engineering, and nanotechnology. The centre aims to establish the collaboration with certain prestigious National and International institutions and Universities to boost the research and development. Its

collaborative approach not only accelerates the pace of research and development but also ensures that the benefits of these innovations are widely accessible, marking the centre as a pivotal player in the global scientific community.

Infrastructure and Facilities

The centre boasts an array of sophisticated equipment and facilities designed to support the intricate processes involved in nanomaterial synthesis and manipulation. Key facilities include:

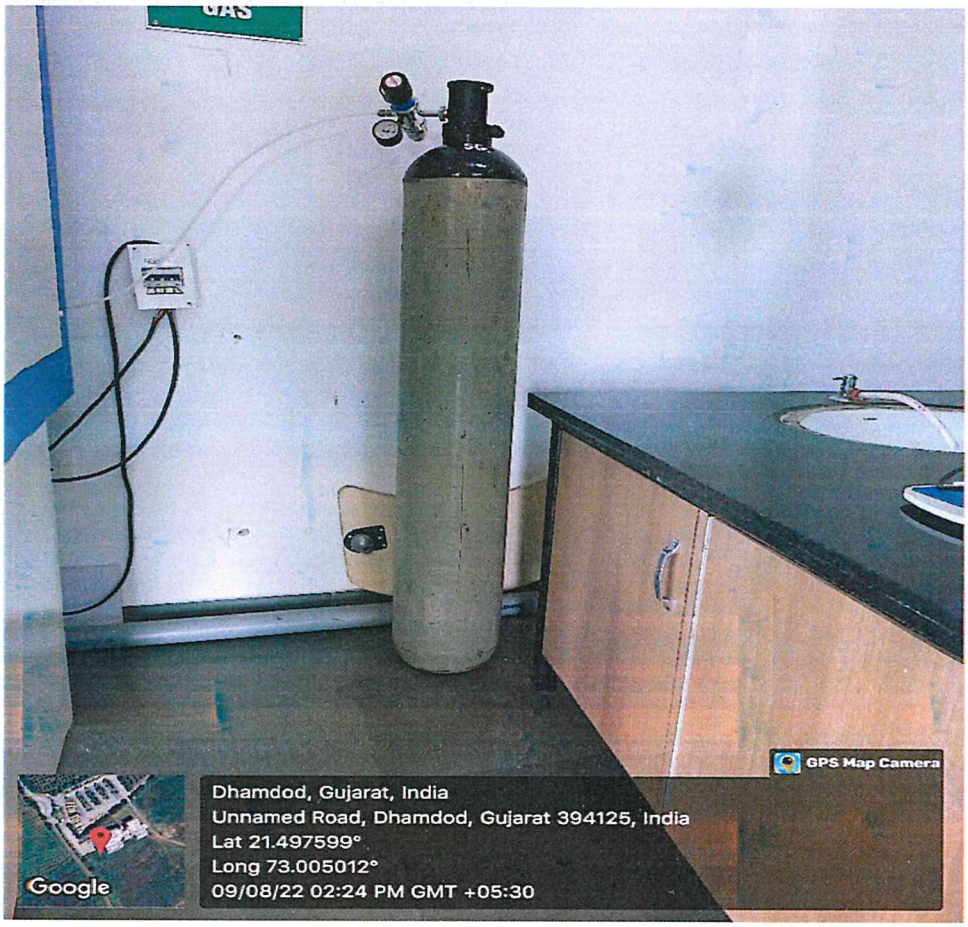
- Fume Hood: A fume hood is a type of ventilation system used in laboratories where harmful chemicals or fumes are handled. It consists of an enclosed workspace with a moveable window at the front, and it is connected to an exhaust system that removes potentially hazardous fumes and gases from the workspace. In the centre, these fume hoods ensure a controlled and ventilated environment for the synthesis of nanomaterials and polymers.

- Sonicator: It is an instrument used in laboratories to apply ultrasonic energy to a sample for various purposes, such as dispersing, emulsifying, mixing, or extracting compounds. It consists of a generator that produces high-frequency electrical signals, which are then converted into mechanical vibrations by a transducer. These vibrations are transmitted to a probe or a horn, which is immersed in the sample. The mechanical vibrations create ultrasonic waves in the sample, leading to the disruption of particles, cells, molecules or facilitating chemical reactions. In centre, it is used for the uniform distribution of nanomaterials within solvents, crucial for the preparation of composite materials.

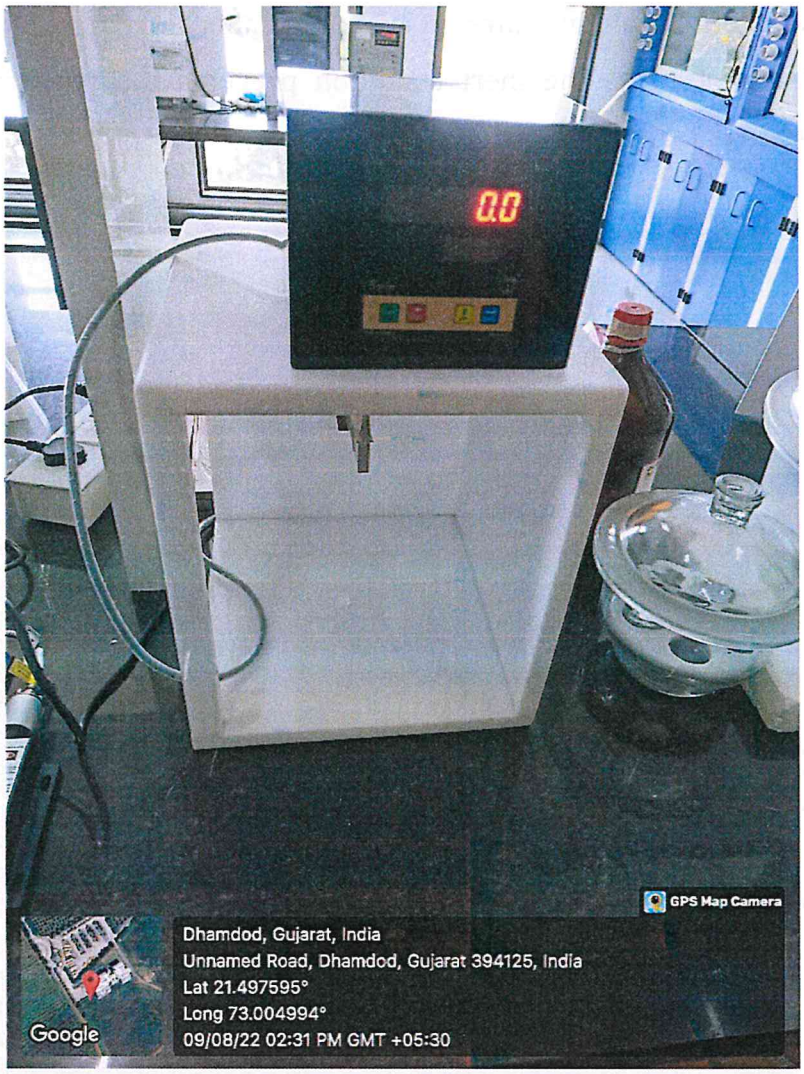
- Vacuum Oven: A vacuum oven is a type of oven used in laboratories and industrial settings for processes that require controlled heating under reduced atmospheric pressure. In centre, it provides the necessary conditions for the polymerization processes (Especially in case of solvent casting) and the thermal treatment of materials, enabling the controlled synthesis of polymers. The vacuum pump of the oven is linked with a Teflon pipe and placed under the hood chamber so that the chemical fumes can go outside the laboratories.

- Inert Gas Supply: Inert gas supply is used for creating the inert atmosphere for any specific condition and limiting the unwanted reaction such as oxidation due to the

presence of O_2 in air. In centre, an inert atmosphere is required for certain polymer synthesis process. The inert condition prevents the reactive materials from oxidation and degradation.



- Stress Recovery Ratio Equipment: The Stress Recovery Ratio (SRR) equipment is a device used in materials science and engineering to measure the recovery of a material from deformation-induced stresses. This equipment is particularly relevant in the study of viscoelastic materials, which exhibit time-dependent behavior when subjected to stress. In centre, this specialized equipment is used to evaluate the performance of materials developed for remote actuation, assessing their ability to recover their original shape after deformation.



- FL-IR: FLIR instruments are devices that detect infrared radiation emitted by objects and convert it into an image or video. In centre, FLIR used to measure and visualize temperature distributions in experiments involving heat transfer, thermodynamics, and thermal properties of materials. It also captures and observes the heat absorbing capacity of the prepared composite.

- NIR 808nm Laser and Modulator: NIR lasers emit light in the near-infrared spectrum, typically around 808 nanometers (nm). This wavelength falls within the near-infrared range, which extends from about 700 nm to 2500 nm. A modulator is a device that controls the intensity or other characteristics of a light beam, usually in response to an external signal. In the context of NIR lasers, a modulator can be used to modulate (i.e., control) the output of the laser beam. In centre, these advanced tools are employed in the testing and application of remote actuation technologies, allowing for precise control and activation of materials using near-infrared light.

Photos with Label

Research and Development Focus

The core of the centre's research revolves around the synthesis of nanomaterials and polymers, and the functionalization of these materials to enhance their properties and applicability. A significant area of focus is the development of materials for remote actuation, leveraging the unique properties of nanocomposites for applications requiring precise control and responsiveness. This includes the exploration of shape-memory polymers, electroactive polymers, and nanocomposite materials that respond to external stimuli such as temperature changes, electromagnetic fields, and light. In addition to their applications in remote actuation, the synthesized nanomaterials and polymers hold promise for a wide range of other cutting-edge applications such as antimicrobial sheets which can be used for biomedical devices, energy storage systems, and environmental remediation technologies.

Collaborations and Applications

The synthesized and functionalized materials find applications in various fields, with a primary focus on remote actuation systems that can be applied in robotics, aerospace, biomedical devices, and smart textiles. These materials enable precise control and manipulation of components and structures from a distance, revolutionizing the capabilities of autonomous systems and enhancing human-machine interaction. The center's work in nanomaterials also extends to energy applications, where these materials can contribute to the development of solar cells that are more efficient, batteries with higher energy density and longer cycle life, and supercapacitors capable of rapid energy storage and release. These advancements are critical for addressing global energy challenges and transitioning towards sustainable energy solutions. Collaboration is a cornerstone of the center's philosophy, with researchers actively sharing materials and findings with partner laboratories and institutions. By fostering open collaboration and knowledge exchange, the center accelerates the translation of research discoveries

into practical applications, driving innovation and addressing real-world challenges more effectively. This collaborative approach ensures that the benefits of scientific advancements are maximized and accessible to a wider audience, ultimately contributing to societal progress and well-being.

Incharge **Principal** **Registrar**

Registrar
P P Savani University