CENTRE FOR FUNCTIONAL MATERIALS

Centre Vision and Mission

To be locally and globally recognized in cutting-edge research, education and innovation related to functional materials, ultimately catering to the societal needs.

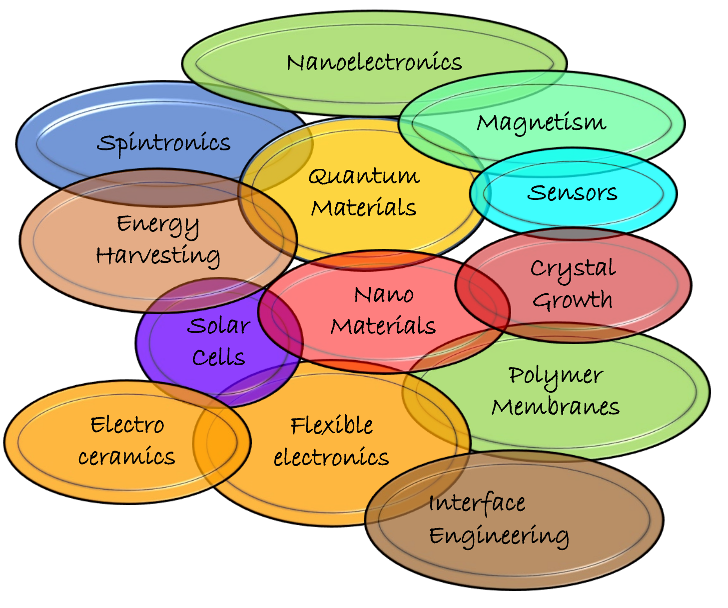
- To create most advanced research facilities for synthesize functional materials through national and international projects.
- To employ scientists who are experts in their field and address the nation's research challenges.
- To enable the members to carry out high-impact research for future technological challenges.
- To design and implement research oriented and industry-ready curriculum at the post-graduate level.
- To develop and strengthen collaboration with universities, institutes and industries at the global level leading to patents, product development and technology transfers.

About the Centre

The Centre for Functional Materials (CFM) (Formerly Centre for Crystal Growth - CCG) at VIT, Vellore was established in December 2016.

The centre aims :

- To establish a state of the art R&D centre to facilitate research activities in the future technologies.
- To work in the research areas which directly/indirectly benefit the society.
- Synthesize materials which respond to the external stimuli can be called as Functional materials and cover range of material classes ranging from Semiconductors to Polymers and Molecular crystals to Nanoparticles.
- From fundamental science to technologically relevant research topics by fabricating devices in micro and nanoscale.



- CFM has also been active in providing various material characterization facilities like Z-scan, laser damage threshold, optical studies, micro hardness measurement, dielectric analysis - LCR meter and surface etching studies, photoconductivity and refractive index measurements.

CFM has **8** core faculties and more than **40** research scholars and project associates. The Centre faculty are actively engaged in teaching various courses in M.Sc.(Physics) and undertaking research projects for Masters and Ph. D. Scholars.

Objective and Highlights

Preparing, processing and exploring structure-property correlations in functional materials at the bulk and nanoscale resulting in accelerated new materials development. Specific development of functional materials for sensors, magnetic storage, energy conversion, communication, various electronic and multifunctional devices including energy harvesters, actuators and transducers, spintronic devices.

Our research focuses mainly on the understanding science and engineering at nanoscale via synthesizing nanomaterials, thin films ceramics, biomaterials, polymers, laser shock wave processing, metals, magnetic materials, optical materials and crystal growth.

Our centre is distinct because it will focuses on futuristic, technologically relevant research for society

Further the centre aims to focus on fabricating next generation devices in the areas of energy harvesting, quantum technology and spintronics.

Dr. R. Ezhil Vizhi, Ph.D. (VIT Vellore)

Director

Centre for Functional Materials

Email : rezhilvizhi@vit.ac.in

director.cfm@vit.ac.in

R. Ezhil Vizhi is a Professor at the Centre for Functional Materials, VIT. She obtained her Master's degree in Physics from Rajah Serfoji Govt. College, Thanjavur, Bharathidasan University. She completed her M.Phil. degree in Physics from Queen Mary's College, Chennai and Doctoral degree in Physics (Materials Science) from Vellore Institute of Technology, Vellore. She joined VIT in 2001 to work and doing research in Materials Science. Her research works revolves around two fields namely crystal growth and nanomagnetic materials. Synthesizing organic, inorganic and semi organic crystals for NLO application have been one part of her work. The second part is research on magnetic nanomaterials mainly revolves around the characterization of soft and hard ferrites for permanent magnet applications.

Her research laboratory focuses on the design and development of multifunctional nanomaterials for permanent magnet, spintronics, recording media and biomedical applications. She has produced five Ph.D students and presently guiding six research scholars in the field of crystal growth, nanomagnetic materials and thin films. She has authored over 53 research publications, 62 conference presentations and 2 books. She has been reviewer in reputed international journals.

Dr. Ezhil Vizhi has received several recognitions in her research career which includes the Active Researcher award from Vellore Institute of Technology [VIT] (2011 to 2019), Fast Track Young Scientist Fellowship from Department of Science and Technology [DST] (2012), Woman Achiever Award from Vellore Institute of Technology [VIT] (2020). She has also received a grant from Department of Science and Technology [DST- EMR] in 2017. She is a life member of Indian Association for crystal growth and Magnetic Society of India.

Dr. Palanisami N, Ph.D. (IIT Bombay)

Dr. Palanisami is a professor at the centre for Functional Materials. He obtained his Ph.D. from IIT Mumbai in 2006 and then moved to Institüt für Anorganische Chemie, Julius-Maximilians-University of Wurzburg, Germany until 2010. He was visiting research professor-Brain Pool Fellowship (2013-2014) at Korean Federation of Science and Technology (KOFST), Suncheon National University in South Korea. He has been awarded with outstanding Reviewer by The Editors of Inorganic Chemistry Communications, Elsevier publications and from Dec 2006-Nov 2007, he was awarded the Bayerische Forschungsstiftung postdoctoral Fellowship, Germany

Dr. Palanisami works mainly in the areas of Optical and non-linear optical studies of main group borasiloxanes, Non-linear optical studies on ferrocene appended X, Y and H-shaped donor-π-acceptor chromophores and AIE-active ferrocene/non-ferrocene conjugated heterocyclic chromophores for sensor applications.

His research group has successfully finished two funded projects from DST-SERB Fast Track Scheme for Young Scientists, CSIR-Extramural Research Grant. Currently, Dr. Palanisamy's research group is funded with three projects from agencies like DST-Italian bilateral project, CSIR-Extramural Research Grant and DST-SERB Extramural Research.

Dr. S. Kaleemulla, Ph.D. (Sri Venkateswara University, Tirupathi)

Dr. Kaleemulla works in the dilute magnetic oxide semiconductors, transparent conducting oxides and solar cell materials. He has 12 years research experience and 13 years of teaching experience in and around VIT University. He has awarded 8 Ph.D. and published about 90 research articles in various national and internationals peer reviewed journals. He has completed 2 major research projects from UGC-DAE-CSR funding agency. These two projects were mainly on oxide thin films (Cr, Fe, Ni and Cu doped In_2O_3 films and Mn and Fe doped ITO thin films) for spintronic and technological applications. Apart from actively involved in research, Dr. Kaleemulla also teaches Physics and Materials Science to undergraduate students.

Dr. Madhuri W, Ph.D. (Sri Krishnadevaraya University, Anantapur)

Dr. Madhuri W has done her Ph.D. from Sri Krishnadevaraya University, Anantapur in the faculty of Physics. She is Having 20+ years of teaching experience and 18 years of research in material science. Current research is on electromagnetic interference shielding materials synthesis and characterization for Radar applications. She was the principle investigator of a project titled "microwave sintered NiMg and NiMgZn ferrites for EM interference shielding technology" sponsored by DRDO, India during 2013 – 2017. She has guided many PG projects and research scholars on ferrites, hexa-ferrites and ferro-electrics materials. By 2020 six students are awarded Ph.D. degree under her supervision.

She has published several original research articles in various peer reviewed international journals, national and international conferences proceedings. She is the Life member of Magnetics society of India. Dr. Madhuri W is the First Indian recipient of Eleonore-Trefftz Guest Professor Fellowship, Technical University, Dresden, Germany. The publications are here.

Dr. Ramesh Thamankar, Ph.D. (Freie Universität, Berlin, Germany)

Dr. Ramesh Thamankar is an Associate Professor in the Centre for Functional Materials, VIT Vellore. He obtained his Masters in Science (Physics) from Mangalore university and M.Tech. in Materials Engineering from National Institute of Technology, Karnataka. After working in Indian Institute of Science, Bangalore for a year, he went to Germany to pursue Ph.D. at Institute for Experimental Physik, Freie Universität, Berlin, Germany. Here designed ultra high vacuum systems for growth and characterizing ultrathin *3d* alloy films to study the correlation between structural and magnetic properties. In 2004, he went to University of California, Riverside to work in the areas of spintronics and organic electronics. From 2006 to 2009, he worked with Max-Planck Institute for Mikrostrukturphysik in Halle, Germany. Here he developed a process to fabricate ultrahigh density magnetic dots on single crystal metallic surfaces.

From 2010 to 2014, he worked as a scientist in Institute of Materials Research and Engineering (IMRE), A*STAR, Singapore and from 2014 – 2016, as a Senior Research Scientist at Singapore University of Technology and Design (SUTD) Singapore.

His Research focusses on understanding physics at nanoscale and atomic scale. He has published more than 40 international publications and has presented more than 30 presentations/talks in international conferences. He has written 4 book chapters in Advances in Atom and Single Molecule Machines.

Currently, he is working on designing new materials for atomic scale electronics, memories and Neuromorphic computation.

Dr. S. Madeswaran, Ph.D. (Anna University)

Dr. S. Madeswaran is an Assistant Professor (Sr.) of physics at Centre for Functional Materials (CFM) Vellore Institute of Technology. He obtained his Ph.D. degree from Anna University. His Ph.D. research work is on the "Growth and characterization of ferroelectric single crystals and thin films". He did his part of work at Leibnitz Institute for Solid State and Materials Research (IFW) Dresden, Germany under DAAD fellowship. He had been awarded Senior Research Fellowship (SRF) by the Council for Scientific and Industrial Research (CSIR), Government of India.

After his Ph.D., he joined in National Institute for Materials Science (NIMS), Tsukuba, Japan as Postdoc researcher. He worked (2 years) there on the fabrication of Al_2O_3 single crystalline nano-film (~10 nm) for the application of MIM emitter. He then moved to Tokyo University of Science (TUS), Japan and investigated (4 years) hard magnetic (NdFeB) thin films, which are widely used in MEMS applications. He then joined VIT in 2011 and has been involving in teaching and research. His major research areas are ferroelectric/magnetic, energy and NLO materials.

He has wide experience in various characterization techniques (XRD, SEM, AFM, LEED, AES, dielectric, electric & magnetic hysteresis, I-V and microhardness studies). He has to his credit several research papers published in internationally reputed journals. He has also participated and presented his research findings in several national/ international conferences. He has supervised on Ph.D. student and is currently guiding five research students. He is a life member of Magnetic Society of India and Indian Association for crystal growth.

Dr. S. P. Vijaya Chamundeeswari, Ph.D., (VIT VELLORE)

Dr. S.P. Vijaya Chamundeeswari is working as Asst. Prof(Sr),in the department of Physics, Center for Functional Materials at Vellore Institute of Technology, Vellore. She has a teaching experience of more than 20 years with Research Experience of 10 years in the field of Laser Spectroscopy. She has worked in the Area of Laser Spectroscopy with Raman/IR, XRD, NMR, & UV Visible spectroscopy in the study of Drug Compounds/Quantum Chemical Calculations and Spectroscopic Studies of Anti-Biotic & Anti-Epileptic fields. She completed a short term program on DFT calculations of drug compounds at IISc, Bangalore.

She worked as a lecturer in AC college of Engineering &Technology for three years and carried out Scrutiny & counselling Work at DOTE office, Guindy, Tamilnadu. She is a Life member of Indian Laser Association. She has published 12 research papers in an international peer reviewed journal. Presently her research includes, synthesis and characterization of Bio-nano metal-cluster composites for photo catalytic applications

Dr. Ankur Rastogi, Ph.D. (IIT Kanpur)

Dr. Ankur Rastogi is an Assistant Professor at the Centre for Functional Materials, VIT. He obtained her master's degree in Physics in the year 2007 and obtained his Doctoral degree in Physics form Indian Institute of Technology, Kanpur in 2014. After completing his doctoral thesis, he worked as a post-doctoral associate at University of Twente, Netherlands, The University of Alabama, Tuscaloosa, USA, and Oakridge National Laboratory, USA. He worked extensively on ultra-thin oxide films and heterostructures. His research devoted to recognizing and solving key fundamental problems in physics and material science for their applications in energy. His research background includes interface engineering of functional materials, magnetism, spin transport, and thermoelectrics in complex oxides, and device fabrication and characterization.

He has authored over 25 high quality research publications in reputed journals like Nature, Science, Advanced materials, Physical Review Letters, Physical Review B and participated various national and international conference presentations. He is also a reviewer in reputed international journals.

Spin Coating

Spin coating is the simplest method for fabricating a film on a substrate. Thin-resist layers for photolithography are coated with this technique. The spin-coating process starts with the dilution of the material to be deposited in a solvent. The solution is subsequently dispensed on the substrate surface. The wafer is then spun at a high speed. The thickness of the film is determined by the spinning speed, surface tension, and viscosity of the solution. The solvent is removed partly during the spinning process due to evaporation and partly by subsequent baking at elevated temperatures. Spin coating results in a relatively planar surface. This technique is often used for planarization purposes.

Specifications:
Make and Model: Apex-spin NXG-ACH Spin coating unit with vacuum pump and heater Programmable digital process controller for repeatable, processing Maximum 10000 rpm

Faculty In-charge: Dr. R. Ezhil Vizhi

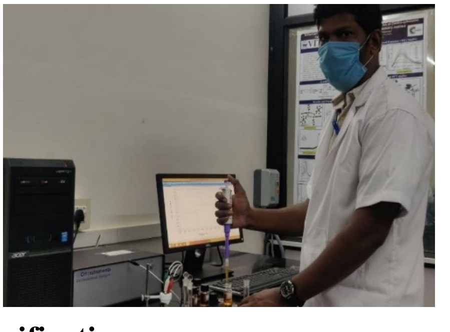
Vicker's Micro-hardness Tester

Hardness tests enable us to evaluate the properties of materials such as ductility, strength and wear resistance that will help us to determine and check if the material is suitable for a wide range of applications, including micro hardness testing. It has a broad load range and also, we can measure the depth of hardness. It will be operated by putting a controlled force on the surface of the material over a period of time. After a particular indenter is pressed into the surface under testing, the indentation resulting from it is measured and the software is also used to analyze and generate precise results.

Faculty In-charge: Dr. R Ezhil Vizhi

Specifications:
Make and Model: Mitutuoyo-HB210
Indent: Diamond Indenter
Magnification: 10x and 50x
Vicker's hardness and Knoop Hardness,
Load: 10 to 1000 kgf (load applied for 10 to 15 seconds)

Electrochemical workstation



Electrochemical workstation provides various analytical techniques such as cyclic voltammetry, chronoamperometry, differential pulse voltammetry, linear sweep voltammetry, square wave voltammetry, etc. windows based software and integrated digital CV simulator and fitting, impedance simulation and fitting program. It is a powerful tool to understand fundamental aspects of electrochemical kinetics and trace level analysis.

Faculty In-charge: Dr. Palanisami N.

Specifications:
Make: CH Instruments, Austin, Texas.
Electrode configuration: 2 and 3 electrodes
Model: CHI620E (±10 V / ±250 mA)

Thermal Evaporation

The vacuum thermal evaporation deposition technique is one of the simple thin film coating techniques.The system can produce an ultimate vacuum of 5×10^{-6} mbar. The vacuum chamber was pumped with a diffusion pump and a rotary pump combination. The pressure in the vacuum chamber was measured using digital Pirani and Penning gauge combination. In this, only one filament is used at a temperature sufficiently high to evaporate even the less volatile material instantaneously. In this method, very small grains of the evaporated alloys are dropped sequentially into the hot boat which immediately vaporize to form a condensate on a nearby heated substrate, ensuring the stoichiometry of the films. This technique allows an excellent control over various deposition parameters to get good stoichiometric films.

Using this technique, the metal and semiconductors in elementary form or compound form can be prepared as thin films. Generally, the materials which have low melting points can be prepared as thin films onto the glass or quartz substrates. Various metals such as indium, tin, zinc, cadmium, aluminum, etc are prepared as thin films and annealed in air to prepared indium oxide, zinc oxide, cadmium oxide, etc. Further the compound materials such CZTS or CIGS were also prepared as thin films for solar cell applications. It can deposit both metals and nonmetals, including aluminium, chrome, gold, indium, and many others. This method of evaporation can be applied to deposit metallic contact layers for thin film devices such as OLEDs, solar cells and thin-film transistors.

Faculty In-charge: Dr. S. Kaleemulla

Electron Beam Evaporation

The equipment Electron beam Gun power supply Model: EGC-3KW has HT and LT transformer, HT inductor, bleeder resistor and with this, at the top controlling unit consist of the voltage and current stabilizer with all the other controls to operate the gun is provided. Beam voltage indicated on two wide view meters provided with 0 to 10 KVDC meter (calibrated on 0-500 micro amp meter) for voltage and 0 to 500 mA DC meter for emission current. And the power supply can connect with Vacuum unit for deposition of thin film. Which consists vacuum chamber and pumping system.

Faculty In-charge: Dr. S. Kaleemulla

PE Loop Tracer

Ferroelectricity is a characteristic of certain materials that have continuous electric polarization that can be reversed by the application of an external electric field. All ferroelectrics are pyroelectric, with the additional property that their natural electrical polarization is reversible. The term is used in analogy to ferrimagnetism, in which a material exhibits a permanent magnetic moment. When most materials are polarized, the polarization induced, P, is almost exactly proportional to the applied external electric field E; so, the polarization is a linear function.

Faculty In-charge: Dr. W. Madhuri

Specifications:
Brand: Marine India
Maximum Field: +5KV/(50KV/cm)
Frequency Range: 20Hz – 1 KHz
Cryogenic Temperature Stage: 100RT (96K – 273K)
Sample Dimension: 2 - 10 mm diameter

Piezoelectric Test Meter

d33 is one of the most useful measurement in estimating the piezoelectric nature of the material. The instrument directly measures the charge accumulated on the end faces per unit force applied. The instrument can measure d33 values for ceramics, polymers and single crystals. The meter can measure the d33 in various crystal directions of a single crystal sample. The meter can give the d33 reading for a variety of sample size and shapes like pellet, toroids, spheres, disks, cylinders, semi spherical shells etc.

Faculty In-charge: Dr. Madhuri W

Specifications:
Make: Sinocera (Model : YE2730)
Range: 10 to 2000 pC/N

Composite Piezoelectric Oscillator

The crystal oscillator circuit sustains oscillation by taking a voltage signal from the quartz transducer, amplifying it, and feeding it back to the resonator. The rate of expansion and contraction of the quartz is the resonant frequency, and is determined by the cut and size of the crystal.
Internal friction and modulus are useful probe to examine defects, microstructure and phase transitions as well as important parameters to monitor mechanical behaviour. This study focuses a new piezoelectric composite oscillator method for modulus and internal friction measurement. The technique is appropriate to the evaluation of small-size ceramics test piece with 1-3mm thickness, 2-4mm wide and 10-40mm length. This technique can be applied to the measurement at elevated temperatures up to 800°C under direct heat environment without buffer materials.

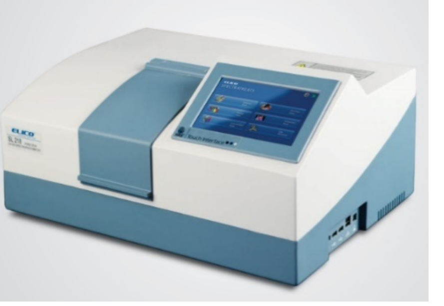
Faculty In-charge: Dr. Madhuri W

Specifications:
Make: Mittal Enterprises, India.
Temperature: 30 to 150°C
Quartz: X-cut

Double beam UV-Visible Spectrophotometer

Low dimensional Materials, Optical energy gap calculations. Semiconductors material characterisation Organic compounds in Biological matter. The double beam spectrophotometer can be used to determine the absorption and transmission spectra within the wavelength range of 190-1100nm with an accuracy of ±0.5nm. This spectrometer has the option of selecting the light source between Deuterium Lamp (D2) and tungsten (W) halogen lamp.

Faculty In-charge: Dr. R. Thamankar

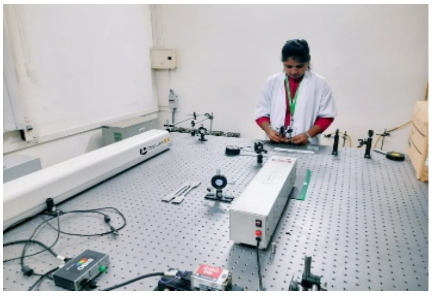


Specifications :
Brand : ELICO
Model : SL218
Deuterium Lamp (D_2)
Tungsten (W) Halogen Lamp

Laser Shock Peening Setup

A process of materials that induces residual compressive stresses on the surface of a component due to shock waves produced by plasma". Laser peening (LP), or laser shock peening (LSP), is a surface engineering process used to impart beneficial residual stresses in materials. Laser peening uses the dynamic mechanical effects of a shock wave imparted by a laser to modify the surface of a target material. Fundamentally, laser peening can be accomplished with only two components: a transparent overlay and a high energy pulsed laser system. The deep, high-magnitude compressive residual stresses induced by laser peening increase the resistance of materials to surface-related failures, such as fatigue, fretting fatigue and stress corrosion cracking. Laser shock peening can also be used to strengthen thin sections, harden surfaces, shape or straighten parts (known as laser peen forming), break up hard materials, compact powdered metals and for other applications where high pressure, short duration shock waves offer desirable processing results.

Faculty In-charge: Dr. S Madeswaran

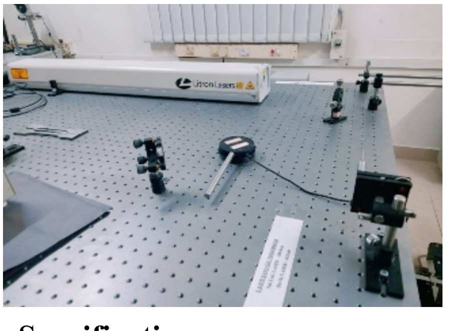


Specifications:
Brand : Litron Lasers
Laser medium : Nd-YAG Laser
Energy - 400 mJ
Laser Wavelength - 1064nm
Pulsed duration - 6ns

Laser Damage Threshold

The laser damage threshold (LDT) or laser induced damage threshold (LIDT) is the limit at which an optic or material will be damaged by a laser given the fluence (energy per area), intensity (power per area), and wavelength. LDT values are relevant to both transmissive and reflective optical elements and in applications where the laser induced modification or destruction of a material is the intended outcome. For long pulses or continuous wave lasers the primary damage mechanism tends to be thermal. Since both transmitting and reflecting optics have non-zero absorption, the laser can deposit thermal energy into the optic. At a certain point, there can be sufficient localized heating to either affect the material properties or induce thermal shock. Dielectric breakdown occurs in insulating materials whenever the electric field is sufficient to induce electrical conductivity. For very short, high power pulses, avalanche breakdown can occur.

Faculty In-charge: Dr. S Madeswaran



Specifications:
Brand : Litron Lasers
He-Ne Laser-632nm

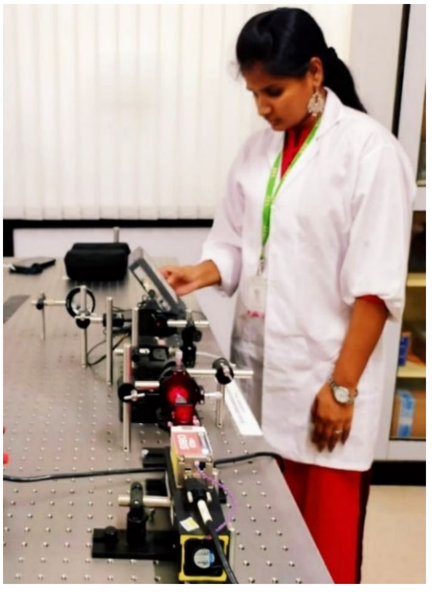
Second Harmonic Generator

Second harmonic generation (SHG), also called frequency doubling, is a nonlinear optical process, in which photons interacting with a nonlinear material are effectively 'combined' to form new photons having twice the frequency of initial photons. It is a special case of sum-frequency generation (2 photons), and more generally of harmonic generation. Crystal materials lacking inversion symmetry can exhibit a so-called $\chi^{(2)}$ nonlinearity. This can give rise to the phenomenon of frequency doubling, where an input (pump) wave generates another wave with twice the optical frequency (i.e. half the vacuum wavelength) in the medium. This process is also called second-harmonic generation.

Specifications:
Make : THOR Labs
Laser-Nd-YAG Laser (1064 nm)

Faculty In-charge: Dr. S Madeswaran

Z-Scan Technique



Z-scan technique is used to measure the nonlinear optical properties of materials. The Z-Scan helps to determine intrinsic photo-physical properties of materials by focusing a single laser beams onto the surface of the materials sample. The laser beam is directed perpendicular to the plane of the sample. The sample is moving along the z direction (the laser beam propagation direction) in and out of the laser focal point. The transmitted signal goes either directly to a detector or through an aperture to a detector. The magnitude of the detected signal is plotted as a function of the sample position. "Open aperture" measurement allows determining the nonlinear absorption of the material. Whereas in the "closed aperture" measurement, the magnitude and sign of the nonlinear index of refraction resulting from the Kerr effect can be determined. Changes in the nonlinear index of refraction lead to nonlinear distortions of the beam. A positive Kerr effect leads to self-focusing of the laser beam. A negative Kerr effect leads to defocusing. Usually, measurements need to be taken at different laser pulse energies or different laser pulse lifetimes in order to determine what nonlinear processes are present.

Specifications:
Make : THOR Labs
Laser-Nd-YAG Laser (1064 nm)

Faculty In-charge: Dr. S Madeswaran

Bridgeman Technique for Crystal Growth

The Bridgman technique (also known as Bridgman Stock Barger method) is one of the oldest techniques used for growing crystals. In Bridgman technique, the crucible containing the molten material is translated along the axis of a temperature gradient in a furnace. In Stock Barger technique, there is a high-temperature zone, an adiabatic zone and a low- temperature zone. Stock Barger's modification of the Bridgman technique allows for better control over the temperature gradient at the melt crystal interface. This is the most important and widely used method of crystal growth.

Faculty In-charge: Dr. S Madeswaran

Specifications:
TRMC-1500°C MOS12 Furnace Control Unit, Translational and Rotational Motion System for Crystal Growth

Abbe Refractometer

Abbe refractometer is a widely used bench-top device for the high-precision measurement of an index of refraction. Refractive index is an important optical constant used to determine the optical performance of the material. Working principle of Abbe refractometer is based on critical angle. Sample is put in between two prisms, measuring and illuminating prisms. Light enters into the sample from the illuminating prism, gets refracted at critical angle at the bottom surface of measuring prism, and then the telescope is used to measure position of the border between bright and light areas, from which the refractive index of the material will be obtained.

Faculty In-charge: Dr. S. Madeswaran

Specifications :
Make : ATAGO, NAR-4T
Range : 1.4700 to 1.8700
Accuracy: ±0.0002
Temperature range: 5 to 50° C

Gas Sensor Testing Unit

Gas Sensor testing unit is a system designed to reproduce environmental conditions in which a Gas Sensors device will be operated. In this gas sensor unit, argon and nitrogen can be sensed. This furnace is suitable for operating under multiple gaseous environments. Sensors based on metal oxide semiconductors are mainly applied to detect target gases through redox reactions between the target gases and the oxide surface. Initially through redox reactions, the O − distributed molecule on the surface of the materials will react with molecules of target gases, leading to an electronic variation of the oxide surface and then this variation is transduced into an electrical resistance. LabVIEW software is the interface used to get the output data.

Faculty In-charge: Dr. Ramesh. M. Thamankar

Specifications:
Make : VB Ceramic consultants
Shell design: Suitable for vacuum and pressure (1mbar)
Maximum temperature: 600°C (accuracy ±1°C)
Rotary vacuum pump (10^{-1} mbar)
Mass flow controller

Magnetron Sputtering

Magnetron sputtering is extremely basic and useful tool to deposit thin films. The high voltage is applied to the sputtering gun which ionizes the sputtering gas. These high energy ions create gaseous plasma when bombarded on the target material to be deposited. The gaseous plasma contains the material to be deposited. The atoms travel in vacuum and deposited onto a desired substrate to form a thin film of target material. One can tune the sputtering pressure, substrate temperature to get the optimized thin film. It is utilized for of Solar cell, Sensors, Transistors applications, and Metal electrode deposition.

Specifications:
Brand : VacuTech Systems
Two sputtering guns (DC and RF)
Maximum power 300 W
Temperature: 500°C
Base pressure: 1×10^{-6} mTorr

Faculty In-charge: Dr. Ankur Rastogi

Battery Tester

Instrument BCS 805 series battery cycling system is a modular system that addresses the expanding needs in testing the battery cycling efficiency. The module is composed of 8 channels and ensures better accuracy in current control and measurement with 5 current ranges. This instrument can work over a frequency range 10kHz to 10mHz for accurate and fast determination of the battery internal resistance. This instrument allows for temperature measurement with K-type thermocouple. It has an 18-bit analog to digital converter for the voltage measurement.

Specifications :
High Quality EIS : Full scan from 10kHz to 10mHz
18-bit A/D converter
HPC measurement down to 6.3ppm
Modularity from few mA to 120A
Voltage measurement from 0 – 9V
2 msec acquisition time

Faculty In-charge: Dr. Ankur Rastogi

Current Research Projects

SI. No	Title	PI name	Funding Agency	Amount Sanctioned (in Rs)	Duration	Status
1	Development of magnetic nanocomposites comprising Ba0.5Sr0.5Fe12O19 /Y3Fe5O12 for permanent magnet applications	Dr. R Ezhil Vizhi	DST-SERB	30.84 Lakh	2017-2021	Ongoing
2	Ferrocene Conjugated Y-Shaped Chromophores as Potential Sensitizers in Dye Sensitized Solar Cells with Innovative Redox Mediators	Dr. Palanisami N.	DST (Interna Ional Division Indo Italian)	16.30 Lakh	2017-2020	Ongoing
3	Unveiling the novel states at the interface between oxide and 2D van der Waals materials	Dr. Ankur Rastogi	VIT	2.0 Lakh	2020-2021	ongoing
4	Second Order Nonlinear Optical Properties of (Ferrocene/non-Ferrocene)-Integrated Linear, X-, Y-, V- and H-shaped Heteroaromatic Push-Pull Chromophores	Dr. Palanisami N.	VIT	2.0 Lakh	2020-2021	ongoing
5	(i) Atomic scale characterisation of singular defects in h-BN (ii) Resistive switching in single layer VO_2	Dr. Ramesh Thamankar	VIT	1.0 Lakh	2020-2021	Ongoing

THIN FILM DEPOSITION TECHNIQUES

1. Spin Coating unit
2. Electron Beam Evaporation
3. Pulsed Laser Deposition Technique
4. Magnetron Sputtering
5. Spray Pyrolysis Setup
6. Thermal Evaporation

MATERIALS SYNTHESIS

1. Planetary Ball Mill
2. Box Furnace
3. Tubular Furnace
4. Microwave Furnace
5. Pulveriser
6. Microwave Reactor Unit

CRYSTAL GROWTH

1. Bridgeman Technique
2. Constant Temperature Water Bath
3. SR Method

CHARACTERISATION TECHNIQUES

1. Vickers Micro-hardness Tester
2. Electrochemical Workstation
3. Phase Sensitive Multimeter
4. Polarization (PE) Loop Tracer
5. Composite Piezoelectric Oscillator
6. UV-Visible Spectrophotometer
7. Laser Shock Peening Setup
8. Z-Scan Technique
9. Gas Sensor Testing Unit
10. Abbe Refractometer

Service Platform

CFM encourages sample analysis to be performed for VIT residents and outsiders. The payment for the sample analysis is through online. Researchers are encouraged to send the samples along with the payment details to the address given below:

The Director
Centre for Functional Materials
Vellore Institute of Technology
Vellore-632014. Tamil Nadu, India.
Email: cfm@vit.ac.in ; Contact: 0416-220-2350

Payment Details

Experiment	Instrument (Make and Model)	Charges (/sample)	In-charge
Vicker's and Knoop hardness	Mitutuoyo-HB210	Rs. 500 /-	Dr. R Ezhil Vizhi
Z-Scan	Coherent 640 OBIS	Rs. 500 /-	Dr. R Ezhil Vizhi
Laser Damage Threshold	He-Ne Laser(632nm), LITRON LASERS	Rs. 500 /-	Dr. S Madeswaran
Laser Shock Peening	Nd-YAG Laser(1064nm), LITRON LASERS	Rs. 1000 /-	Dr. S Madeswaran

Vicker's and Knoop hardness Studies

It will be operated by putting a controlled force on the surface of the material over a period of time. After a particular indenter is pressed into the surface under testing, the indentation resulting from it is measured and the software is also used to analyze and generate precise results.

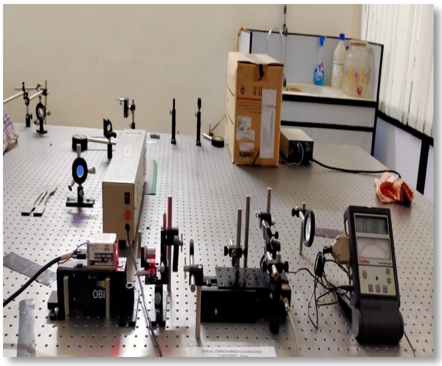
Specifications:

Make and Model: Mitutuoyo-HB210
Indent : Diamond Indenter
Magnification : 10x and 50x
Load : 10 to 1000 kgf (load applied for 10 to 15 seconds)
Vicker's hardness and Knoop Hardness with AVPAK software

Sample Preparation: For a high-accuracy measurement, the test should be performed on a flat specimen with a polished or prepared surface. The quality of the required surface is dependent on the force used. In all tests, the indentation perimeter and depth should be clearly defined when observed by the microscope.

Contact person: Dr. R Ezhil Vizhi, CFM, VIT Vellore

Z-Scan Technique



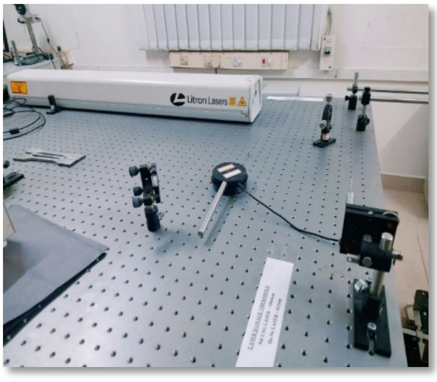
Z-scan technique is used to measure the nonlinear optical properties of materials. The Z-Scan helps to determine intrinsic photo-physical properties of materials by focusing a single laser beams onto the surface of the materials sample. Usually, measurements need to be taken at different laser pulse energies or different laser pulse lifetimes in order to determine what nonlinear processes are present.

Specifications:
Laser Made : Coherent 640 OBIS
Laser wavelength : 640 nm
Software : Coherent connections
Z- Scan controller unit made: Holmarc
Maximum output power: 44 mW

Sample Preparation : Sample (of size 1mm x 1- 10 mm x 1-10 mm) should be flat with a polished surface.

Contact person: Dr. R Ezhil Vizhi, CFM, VIT Vellore

Laser Damage Threshold



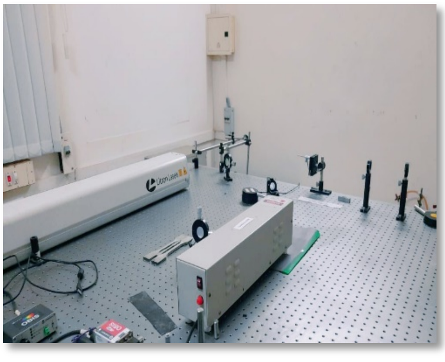
The laser damage threshold (LDT) or laser induced damage threshold (LIDT) is the limit at which an optic or material will be damaged by a laser given the fluence (energy per area), intensity (power per area), and wavelength. LDT values are relevant to both transmissive and reflective optical elements and in applications where the laser induced modification or destruction of a material is the intended outcome.

Specifications: He-Ne Laser-632nm (Litron Lasers)

Sample Preparation: Sample (1mm × 1- 10 mm × 1-10 mm) should be flat with a polished surface.

Contact person: Dr. S Madeswaran, CFM, VIT Vellore

Laser shock Peening



A process of materials that induces residual compressive stresses on the surface of a component due to shock waves produced by plasma". Laser peening (LP), or laser shock peening (LSP), is a surface engineering process used to impart beneficial residual stresses in materials. Laser peening uses the dynamic mechanical effects of a shock wave imparted by a laser to modify the surface of a target material. Fundamentally, laser peening can be accomplished with only two components: a transparent overlay and a high energy pulsed laser system. The deep, high-magnitude compressive residual stresses induced by laser peening increase the resistance of materials to surface-related failures, such as fatigue, fretting fatigue. Laser shock peening can also be used to strengthen thin sections, harden surfaces, shape or straighten parts (known as laser peen forming), break up hard materials, compact powdered metals and for other applications where high pressure, short duration shock waves offer desirable processing results.

Specifications: Litron Lasers
Medium :(Nd-YAG Laser, 400 mJ)
Wavelength : 1064nm
Pulse Width : 6nsec

Contact person: Dr. S Madeswaran, CFM, VIT Vellore

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