A training session report on

Advances in Characterization of Materials

Under

STUTI program funded by DST

In association with

Indian Institute of Technology, Gandhinagar

(Project Management Unit)

Coordinated By

Dr. Naveen Kumar Acharya

Applied Physics Department

Faculty of Technology and Engineering

The Maharaja Sayajirao University of Baroda Vadodara, India

(1st MERU University in Gujarat)

12th to 18th September, 2022

Acknowledgement

We convey gratitude for the encouragement and support received from multiple sources during the execution of this training since its beginning. First and foremost, we want to express our sincere appreciation to the Department of Science and Technology (DST) and IIT Gandhinagar for entrusting us with this project. We would like to thank to Prof. Vijay Kumar Srivastava Honorable Vice-chancellor, The Maharaja Sayajirao University of Baroda, Vadodara for encouraging to host the DST-STUTI program.

The DST-STUTI training program was conducted at Applied Physics Department, Faculty of Technology and Engineering, The Maharaja Sayajirao University of Baroda, Vadodara as a part of golden jubilee celebration of department. The workshop was conducted on "Advances in Characterization of Materials" supported by DST on the instruments funded by DST-FIST program (SR/FST/PS-II/2017/20). Organizing team acknowledge the contributions of the experts, teaching staff, non-teaching staff and research scholars of the department for execution of the successful program to achieve the objectives of the DST-STUTI. We are thankful to Dr. S. N. Acharya, Scientist H, BARC, Mumbai for accepting our invitation as chairperson of inaugural ceremony. We are also thankful to all the experts and participants for their presence during the program.

We would also like to thank to all the teachers, research scholars, and staff of department and members of organizing team for smoothing the program. We also acknowledge IIT, Gandhinagar for their constant support and guidance.

Dr. N. K. Acharya
Coordinator
DST-STUTI program

Dr. C.G. Limbachiya
Head
Applied Physics Department

Summary

The goal of this training session is to popularize DST-FIST instruments among students, faculty, scientists and industry professionals through a week-long training workshop. The workshop was conducted at Applied Physics Department from 12th to 18th September 2022 and comprised of lectures and hands on training sessions. This initiative is funded by Department of Science & Technology under the program ***STUTI*** *(Synergistic Training Program Utilizing the Scientific and Technological Infrastructure)*. This workshop was aimed to provide an insight into the basic principles and various techniques i.e X-Ray Diffraction, Differential Scanning Calorimetry (DSC), UV-Visible spectroscopy, 3-D microscopy and data analysis and interpretation, applications of these techniques in Physical, Chemical, Material, Pharmaceutical and Biological sciences. The participants were introduced to the basic concepts of various techniques such as, data acquisition, image generation, instrumentation, troubleshooting and the advanced modes of operation. The focus of this workshop was to have a proper *balance between theory and practical training on the equipment*. *Emphasis is on hands-on use of equipment for demonstration/characterization by each participant and analysis of participant's samples"*.

Introduction

Applied Physics Department conducted 7-day long workshop on DST- FIST funded instrument on 'Advances in Characterization of Materials' workshop in its premise. Participants from various backgrounds such as Post Graduate, Professors, Scientists, B.E./B.Tech. Ph.D. and Post-Doctoral Fellows and Industry persons were invited **(Annex-1).** The following workshop's activities took place from 12th to 18th September 2022 **(Annex-2 & 3)**. This report provides a quick overview of both the lecture and technical sessions.

- *Lecture sessions*

Dr. S.N.Achary, Scientist H, BARC, Mumbai explained about the responsibility and research. **Dr. P. K. Kulriya** (Associate Professor, J.N.U., New Delhi) delivered a talk on the essential principles and physics behind the operation during X-ray diffraction in significant detail. **Prof. Arun Anand** (Department of Physics, SPU, Vallabh Vidyanagar) discussed 3-D microscopy techniques as well as the importance of holography. **Prof. Utpal Joshi** (Department of Physics, Gujarat University) discussed diffraction and microscopy techniques as well as the importance of spectroscopy in material science. **Prof. Arun Pratap** (Retd.) (Department of Applied Physics, M.S. University) gave a detailed lecture on differential scanning calorimetry, as well as on the advances in DSC technique. **Dr. KVR Murthy** (Department of Applied Physics, M.S. University) gave a detailed lecture on Photoluminescence. **Dr. Rupesh Dewan** (Department of Material Science, IIT, Indore) discussed key elements of UV-Visible spectroscopy and XPS techniques and their use in materials characterization. **Dr. M.M. Jotani** (Bhavans College, Ahmedabad) discussed single crystal XRD. **Prof. P.K. Jha** (Department of Physics, M.S. University) gave a comprehensive presentation on Raman spectroscopy and its applications. **Dr. J.K. Valand** (Department of Material Science, SPU, Vallabh Vidyanagar) discussed key aspects of BET theory and its use in materials characterization. **Dr. Himanshu Srivastava (**RRCAT, Indore) discussed the Transmission Electron Microscopy (TEM) and its applications. **Prof C.N. Murthy** explained about the role of membrane science in detail.

- *Technical Sessions*

On the **first day**, **participants provided a** general overview of research activities in material characterization technique in various disciplines of science and lab visits in the department. On **second day,** detailed demonstration on X-ray diffraction and its analysis involved using software. On **third day, working of** DSC and UV-Visible spectrometer were demonstrated and samples of participants were analyzed. This session was coordinated with their colleagues namely **Dr. Kevil Shah**, **Mr. Kaushal Agheda**, **Mr. Harsh Patel**, **Ms. Margi Patel**, **Dr. Avani Patel, Mr. Subhash Utadiaya and Ms, Shivani Patel**. Next three days were focused on hands-on training sessions for the participants. Participants were provided an overview on the operation of the instrument, data acquisition, and analysis of data and troubleshooting of the equipment. On **Fourth day,** hands-on session for participants on Photo-luminescence instruments held in batches. On **Fifth day**, participants were introduced for hands-on on UV-Visible spectroscopy and XPS techniques and discussed about the research elements in materials characterization. On **sixth day**, hands-on experimental session on single crystal XRD and Raman spectroscopy was held. On the **Seventh day**, showed a demonstration on Transmission Electron Microscopy (TEM) and its applications. Finally, the *Valedictory* function was conducted in the presence of guest of honor **Mr. Sunil Gidvani**, Head, QA/QC, Reliance Industries Ltd. India.

Types of samples tested

During the technical session, all the participants expressed an interest in learning from the workshop and characterized few samples. Participants brought their samples for different characterization and almost 85 (*Eighty-Five*) samples were characterized using X-ray diffraction, differential scanning calorimetry, UV-Vis and other techniques. There samples are in the form of powder, thin films, and polymer sheets.

Outcome of the workshop

The STUTI workshop attracted participants from 18 different institutes (**Figure 1**). Almost 135 participants across the nation have been registered for the program, out of these 31 participants from five different states were allowed to attend. There were 76 % of male and 24 % of female participants. 31 participants enrolled and attended the training sessions on 'Advances in Characterization of Materials'. The goal of this training event was to bring together participants from many disciplines and raise awareness of the institute's advanced facilities. Throughout the sessions, participants asked major questions regarding theoretical and practical aspects of characterization instrumentations, techniques of developing good quality knowledge. This DST-STUTI workshop bought national level institutes and university together at one platform. Finally, the feedback from the participants was considered in evaluation of the workshop (**Annex-4**). Almost all the participants were pleased with the training session and suggested that more workshops be held in the future. Few participants suggested organizing such a workshop/training session on more troubleshooting techniques of data collection and for software analysis.

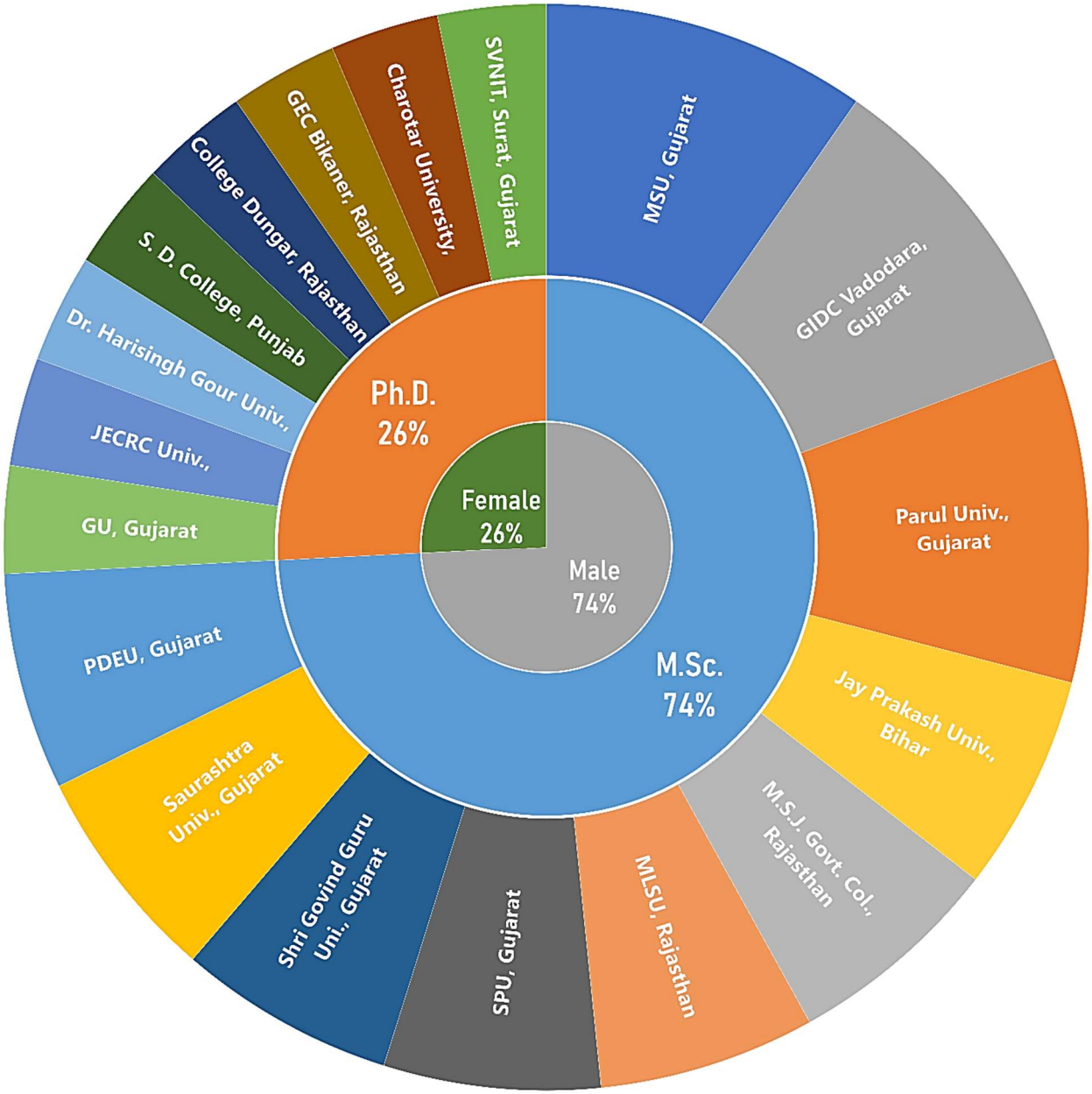

Figure 1: Participants registered for the 'Advances in Characterization of Materials workshop from 18 different institutes.

Annex 1: Brochure for the program.

Department of Science and Technology (DST) Funded

7-days Training and Workshop on

ADVANCES IN CHARACTERIZATION OF MATERIAL

Venue - Applied Physics Department, MSU

12th -18th, September 2022

Synergistic Training program Utilizing the Scientific and Technological Infrastructure' (STUTI)

The Maharaja Sayajirao University of Baroda

Faculty of Technology & Engineering

About Department

The postgraduate course in applied physics is one of its kind which is offered in very few universities across the country. The department comprises of various research groups working in the fields of condensed matter physics, applied optics and photonics, luminescence, theoretical physics, nano-crystalline alloys, laser diodes, fluorescent and display materials etc. They have made contributions in their respective fields through publications in internationally acclaimed Journals.The department has received major research funding from various Govt. of India funding agencies like UGC, DST, AICTE, DAE etc. Through these research projects, many new state of the art equipment have been procured.

Eligibility Criteria:

- Minimum qualification: Post Graduate (Science) or B.Tech/B.E. (Technology/Engineering)
- Professors/Scientists/Post-Doc Fellows/Ph.D. Fellows/Industry persons who are actively involved in R & D
- Not more than 3 peoples from one institute

Over view of STUTI

DST welcomes all their participants for the workshop of ADVANCES IN CHARACTERIZATION OF MATERIALS organized under STUTI. The STUTI program envisions hand-on-training and sensitization of the state-of-the-art equipment as well as towards sharing while ensuring transparent access to S & T facilities. DST has identified Applied Physics Department, FTE, MSU to organize the STUTI program.

This workshop aims to provide an insight into the functioning the XRD, DSC, UV-Vis, Digital Holography etc. The participants will be introduced to the basics of characterization techniques, instrumentation and digital imaging and analysis. The participants will be provided hand-on experience of the various techniques and will have a chance to interact with the subject experts and analyze their own sample (with prior approval).

Objective of Workshop

To conduct a 7-day long program aimed to provide hands-on training to the participants on DST funded instruments to promote the expansion of R&D Infrastructure at academic institutions by ensuring transparent access to S&T facilities. STUTI program is also intended to build human resources and its knowledge capacity through open access of S&T Infrastructure across the country. The focus will be on Scientists/ Professors/ PhDs and Post Doc Fellows actively involved in research across various institutions in the country.

Scope of Workshop

- It is essential that the STUTI training include both theoretical and practical sessions in which topic experts give in-depth knowledge of the instrument and its applications.
- Faculty/experts will be engaged to demonstrate their knowledge of the subject and give appropriate study material to participants, along with an introduction to the instrument's fundamentals.
- Participants will be allowed to use the lab facilities and also be allowed to bring their research samples for examination/characterization from the existing S&T facilities.

Speakers

Dr. P. K. Kulriya
Associate Professor
School of Physical Sciences
Jawaharlal Nehru University, Delhi

Dr. Rupesh Devan
Associate Professor
Department of MEMS, IIT - Indore

Prof. Arun Pratap
Retired Professor
Applied Physics Department
Faculty of Technology and Engineering
The M. S. University of Baroda
Vadodara

Prof. U. S. Joshi
Professor of Physics and Electronics
Gujarat University, Ahmedabad

Dr. Arun Anand
Professor
Department of Physics , S.P. University
Vallabh Vidyanagar

Prof. Prafulla K Jha
Professor
Department of Physics
The M. S. University of Baroda,Vadodara

Dr. S. N. Achary
Head
Nuclear and Energy Materials Section
Chemistry Division
HBNII, Mumbai

Dr. Chintan Pandya
Torrent Pharmaceuticals Pvt. Ltd.
SEZ Part-II
Dahej

Dr. K.V.R. Murthy
Associate Professor
Applied Physics Department
Faculty of Technology and Engineering
The M. S. University of Baroda
Vadodara

Dr. M. M. Jotani
Associate Professor
Department of Physics
Bhavan's Sheth R. A. College of Science
Khanpur, Ahmedabad

Dr. J. K. Valand
Associate Professor
Department of Materials Science
Sardar Patel University
Vallabh Vidyanagar

Dr. Himanshu Srivastava
Scientific Officer 'F'
Raja Ramanna Centre for Advanced Technology (RRCAT)
Indore

Prof., (Dr.) C. N. Murthy
Dean
Faculty of Technology and Engineering
The M. S. University of Baroda
Vadodara

Dr. N. K. Acharya
Coordinator, DST-STUTI,
Applied Physics Department
Faculty of Technology and Engineering
The M. S. University of Baroda
Vadodara

Registration and Contact details:

- Interested participants must register and only selected candidates would be invited for the workshop.
- For selected candidates Registration Fee, local travel, Boarding and lodging will be covered by DST/Applied Physics Department.
- Interested participant should register through the following link: https://forms.gle/wSn5jBP7ALFvX3f59

For more information:

Email: nkacharya-apphy@msubaroda.ac.in

Registration Deadline: 31st August 2022

Shortlisted candidates will be intimated by email latest by 1st Sept. 2022.

Annex 2: List of participants registered and their attendance for the "Advances in Characterization of Materials" workshop.

Sr. No.	Candidate Name	Gender	Educational Qualification	Email address	University/Institute
1	Darshitsinh R Parmar	Male	M.Sc. (Physics)	darshit.pphd21@sot.pdpu.ac.in	Pandit Deendayal Energy University, Gandhinagar, Gujarat
2	Divya Pandya	Male	M.Sc. (Physics)	divypandya167@gmail.com	
3	Aayushi J Raval	Female	M.Sc. (Applied Physics)	aayushi.raval8943@paruluniversity.ac.in	Parul University, Vadodara, Gujarat
4	Pritesh Rameshbhai Soni	Male	M.Sc. (Applied Physics)	1997prsoni@gmail.com	
5	Ms Shivani Shah	Female	M.Sc.(Physics)	shivani.shah@paruluniversity.ac.in	
6	Dr.Mehulkumar M. Patel	Male	Ph.D.(Polymer Chemistry)	directorgirda@gmail.com	Gujarat Industrial Research & Development Agency, Vadodara, Gujarat
7	Sudip Kumar Maji	Male	M.Sc. (Polymer Chemistry)	sudipmaji000@gmail.com	
8	Dr.Mitesh K.Prajapati	Male	Ph.D. (Polymer Chemistry)	directorgirda@gmail.com	
9	Urvashi Jambukiya	Female	M.Sc. (Physics)	urvashi.jambukiya@gmail.com	Saurashtra University, Rajkot, Gujarat
10	Mayur Parmar	Male	M.Sc. (Physics)	mayurparmar8498@gmail.com	
11	Nileshkumar Parmar	Male	M.Sc. (Applied Physics)	pnileshkumar36@gmail.com	Maharaja Sayajirao University of Baroda, Vadodara, Gujarat
12	Pratikkumar Chimanbhai Lakhani	Male	M.Sc. (Organic Chemistry)	lakhanipratik1@gmail.com	
13	Nandita Baxi	Female	Ph.D. (Microbiology)	nanditabaxi@yahoo.com	
14	Naresh Prajapati	Male	M.Sc. (Physics)	d22ph003@phy.svnit.ac.in	SVNIT, Surat, Gujarat
15	Mehul patel	Male	M.Sc. (Physics)	mehul7568@gmail.com	Shri Govind Guru University Godhra, Gujarat
16	Salman Zabha	Male	M.Sc. (Applied Physics)	salmanzabha1996@gmail.com	
17	Hardi Dilip Patel	Female	M.Sc. (Microbiology)	hardidpatel@gmail.com	Charotar University of Science and Technology, Changa, Gujarat
18	Akshay jadav	Male	M.Sc. (Applied Physics)	akshayjadav43382@gmail.com	Sardar Patel University, Vallabh Vidyanagar, Gujarat
19	Pranav Rathod	Male	M.Sc. (Applied Physics)	prathod2699@gmail.com	
20	Manoj Singh Shekhawat	Male	Ph.D. (Physics)	manoj.shekhawat1@gmail.com	Government Engineering College Bikaner, Rajasthan
21	Akshay joshi	Male	Ph.D. (Physics)	joshiakshay6@gmail.com	College Dungar college, Bikaner city, Rajasthan
22	Sanjay Kumar Singh	Male	Ph.D. (Physics)	sanjay@sdcollegeinstitutions.org	S. D. College (Punjabi University, Patiala), Barnala, Punjab
23	Sushil Kumar Behera	Male	M.Sc. (Physics)	kumarsushil5566@gmail.com	Dr. Harisingh Gour University, Sagar, Madhya pradesh
24	Anisha Bano	Female	M.Sc. (Physics)	anishabano687@gmail.com	University college of science, MLSU Udaipur, Rajasthan
25	Manisha	Female	M.Sc. (Physics)	manishachalka4499@gmail.com	
26	Anand Rawat	Male	Ph.D. (Physics)	anandmsj@gmail.com	M. S. J. Govt. College, Bharatpur, Rajasthan
27	Ashok Kumar Agrawal	Male	Ph.D. (Physics)	ashok.narhar@gmail.com	
28	Vikash Kumar Mukhiya	Male	M.Sc. (Physics)	vikashjpu2021@gmail.com	Jay Prakash University, Chhapra, Bihar
29	Raghuvir Kumar	Male	M.Sc. (Physics)	kumarraghuvir862@gmail.com	
30	Sumitra	Female	M.Sc. (Physics)	sumitra2131@gmail.com	JECRC University, Jaipur, Rajasthan
31	Vishwajit Ranjitsinh Chavda	Male	M.Sc. (Chemistry)	vishwajitchavda1998@gmail.com	Gujarat University

Annex 3: Schedule date and activities during the workshop.

Day/Time	12-09-2022	13-09-2022	14-09-2022	15-09-2022	16-09-2022	17-09-2022	18-09-2022
9:00 am-9:30 am	Registration						
9:30 am - 11:00 am	Inaugural Ceremony	P. K. Kulriya (XRD)	U. S. Joshi (Diffraction/ Microscopy)	K. V. R. Murthy (PL)	Rupesh Devan (UV-Vis)	M. M. Jotani (SCXRD)	J. K. Valand (BET)
11:00 am – 11:30 am	TEA BREAK						
11:30 am - 1:00 pm	S. N. Achary (Keynote)	P. K. Kulriya (XRD)	U. S. Joshi (Spectroscopic Techniques)	Arun Pratap (MDSC)	Rupesh Devan (XPS)	P. K. Jha (Raman Spectroscopy)	H. Srivastava (TEM)
1:00 pm - 2:00 pm	LUNCH						
2:00 pm - 3:30 pm	Chintan Pandya (Materials Characterization)	Arun Anand (Advanced Imaging)	P. K. Kulriya (XRD)	Hands-on/participant's Samples	Hands-on/participant's Samples	Hands-on/participant's Samples	C. N. Murthy (Surface Morphology)
3:30 pm - 4:00 pm	TEA BREAK						
4:00 pm - 5:30 pm	Arun Pratap (DSC)	Arun Anand (Digital Holography)	P. K. Kulriya (XRD)	Hands-on/participant's Samples	Hands-on/participant's Samples	Hands-on/participant's Samples	Valedictory
7:30 pm	**Dinner** at University Guest House						

Annex 4: Feedback

Sr. No.	Content	% Rating
1	Overall grading of the Programme with reference to relevance of course, module/ content etc.	100 % rated 8 or above points
2	Overall grading of the facilities provided by the institute, i.e., Hostel, Mess, Class Rooms, Transport/infrastructure etc.	97 % rated 8 or above points
3	Overall grading of the faculty members conducting the training	100 % rated 8 or above points
4	How do you rate the overall training methodology	100% rated 8 or above points
5	How far the field visit is relevant and related to your research study	97 % rated 8 or above points
6	Usefulness of this training in your current role	100 % rated 8 or above points
7	Usefulness of this training in future work/job you may handle.	100 % rated 8 or above points
8	How far have you benefitted from interaction with the fellow participants of the training	100% rated 8 or above points
9	How far the course material supplied relevant and related to the training curriculum	100 % rated 9 or above points
10	Overall grading of the process of training	100 % rated 8 or above points
11	Your recommendation to your peers/ colleagues for the training Programme	100 % rated 8 or above points