One-Week Course
(on-campus mode)

on

Advances in Physics and Technology of Laser Assisted Materials Processing

(Course Code: 191033M01)

08 – 12 January, 2024

Under

MINISTRY OF EDUCATION SCHEME

on

GLOBAL INITIATIVE ON ACADEMIC NETWORK (GIAN)

Course Instructors:

Dr. Brian Simonds

Physicist
National Institute of Standards and Technology (NIST), Boulder, CO, USA

Dr. Manoj Kumar

Scientific Officer – H & Head
Laser Surface & Materials Treatment Lab, LMP Division, RRCAT, Indore, India

Dr. A. A. Shaikh

Professor & Head
Department of Mechanical Engineering, S V National Institute of Technology, (SVNIT) Surat, India

Dr. Vipul Kheraj

Associate Professor
Department of Physics, S V National Institute of Technology, (SVNIT) Surat, India

Organized by

Sardar Vallabhbhai National Institute of Technology,
Ichchhanath, Surat - 395007, Gujarat, INDIA

❖ Overview:

Lasers are an incredible source of powerful, coherent electromagnetic radiation. The ability to produce highly collimated, monochromatic, and intense beams of light that can deliver a large amount of energy precisely at a confined region, makes it a favorable tool for various industrial applications including materials processing. However, laser assisted materials processing is a complex process incorporating many different physical mechanisms such as absorption, heat generation, heat transfer, melting, vaporization, recrystallization, etc. These interactions also rely strongly on laser characteristics such as power, wavelength, divergence, and beam diameter, in addition to the materials' properties. Thus, the efficient operation of laser-assisted manufacturing processes requires combined knowledge of physics, laser-optics, materials science, metallurgy and mechanical engineering along with many other tangential branches.

The proposed course is designed to provide a review of fundamental concepts involved at the interface of physics and technology of laser-assisted materials processing. The course will discuss state-of-the-art developments in the field at both laboratory and manufacturing scales. The course will also discuss various issues and challenges in the field of laser-assisted materials processing, as well as some recent innovative research that addresses some of these challenges. Overall, this course will disseminate fundamental physics and recent advances in laser-assisted materials processing to the engineers, researchers, and executives working in manufacturing industries or materials processing through discourses, tutorials, simulations, and demonstrations.

❖ Objectives:

The primary objectives of the course are:

- Introduce participants to the fundamental concepts of laser physics, optics and laser-matter interactions.
- Familiarize participants with the modeling of thermal processes at laser-matter interaction zones.
- Introduce state-of-the-art developments in the field of laser-assisted drilling, welding and materials processing.
- Acquaint participants with open problems and challenges in the field of laser-assisted materials processing.
- Enable participants to design and develop customized laser-based solutions for their materials processing applications.

❖ You should attend if you are…..

- Faculty from reputed academic institutions and technical institutions.
- Executive, engineer or researcher/scientist from manufacturing, service and government organizations including R&D laboratories.
- Students at all levels (B.Tech./ M.Sc./ M.Tech./ Ph.D.) & Personnel from Startups.

❖ Last Date of Registration: November 30, 2023

❖ Modules:

Module 1 : **Physics of Lasers**
Fundamentals of light-matter interactions; laser system and its components; characteristics of lasers; Basics of optical processes; laser modes, laser beam-parameters and characteristics; optical components for lasers; industrial lasers and laser-safety; high-power laser radiometry

Module 2 : **Laser-Materials Interactions & Thermodynamics**
Absorption of lasers; heat generation; thermal processes involved in laser-matter interactions; heat equations, heat-diffusion and thermodynamics; modeling and simulations of thermal processes using finite element method (FEM); in-situ process monitoring techniques

Module 3 : **Laser-Assisted Surface Treatments**
Lasers in semiconductor materials processing and surface engineering; effects of absorption coefficients and surface penetrations; laser annealing, laser alloying and surface melting; Laser cladding and surface modifications; lasers in thin-film growth;

Module 4 : **Laser-Welding**
Welding mechanisms; operating characteristics and process parameters; advances in laser-welding technologies, novel approaches, issues and challenges in laser-welding, examples and case-studies

Module 5 : **Lasers Machining for Other Innovative Applications**
Laser marking, cutting and engraving in soft and plastic materials; 3d printing using lasers; low-power laser applications; lasers in diamond industries; novel techniques, development and customizations in lasers-system for novel applications

❖ Steps for Registration:

Please follow the steps below for registering in the GIAN program '*Advances in Physics and Technology of Laser Assisted Materials Processing'*

Step 1: Register at the GIAN portal on the link http://www.gian.iitkgp.ac.in/ by clicking on 'Course Registration/ Participant Login'

Step 2: It shall state – 'Registration to the portal is a one-time affair and will be valid for the lifetime of GIAN'. Once registered in the portal, an applicant will be able to apply for any number of GIAN courses as and when necessary. A one-time Non-refundable fee of 500 /- INR is to be charged for this service. (Please do not confuse web registration with course registration. The course registration fee is separate.)

Step 3: Once done with registration, please select the course '*Advances in Physics and Technology of Laser Assisted Materials Processing'* from the list of courses and confirm it.

Step 4: Send the copy of registration details from GIAN website to the following email: aptlamp@gmail.com . For any query related to the course, you can also contact **Dr. Vipul Kheraj** at vk@phy.svnit.ac.in .

The shortlisted candidates will be informed through email regarding the modalities to pay the registration fee. It is compulsory to attend all sessions in person. Online mode of attendance is not permissible.

❖ Registration Fees:

Industry/ Research Organizations:	Rs. 5900/-*
Faculty from Academic Institutions:	Rs. 2360/-*
Research Scholars/Students; Personnel from Startups:	Rs. 1180/-*

*(*Inclusive of 18% GST)*

The above fee includes all instructional materials as well as a working lunch and refreshment. Accommodation on sharing basis is available on prior booking at institute guest house on payment basis.

❖ Faculty:

Dr. Brian Simonds
Physicist
National Institute of Standards and Technology (NIST),
Boulder, CO, USA

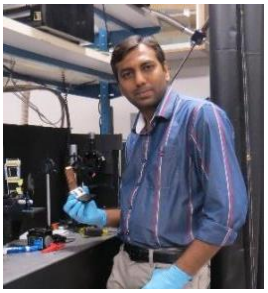
Dr. Brian Simonds obtained PhD in Applied Physics from the Colorado School of Mines (CSM), Golden, CO, USA in 2012. This was followed by a postdoctoral appointment at the University of Utah in Salt Lake City to develop novel laser processes for CdTe thin films. In 2014, Dr. Simonds joined the National Institute of Standards and Technology (NIST) as a National Research Council postdoctoral fellow. He currently works as a Physicist at NIST studying the dynamics of laser/matter interactions and high-power laser radiometry. He also serves as an Affiliate Associate Professor at Colorado School of Mines. Dr. Simonds' research focuses on high powered lasers that are used in manufacturing for welding, cutting, and metal 3D printing.

Dr. Manoj Kumar
Scientific Officer-H & Head,
Laser Surface & Materials Treatment Lab,
RRCAT, Indore, India

Dr. Manoj Kumar is a senior scientist at the Raja Ramanna Centre for Advanced Technology (RRCAT), Indore. He did his Masters of Science in Physics from the Jivaji University, Gwalior, in 1988. In 1989, he joined the RRCAT, Indore, as a scientific officer, where he also obtained his PhD in 2005. He also worked as a visiting scientist at Fraunhofer Institute of Laser Technik, Aachen, Germany in 1996-97. His current area of research inclines towards development of high-power CO_2 Laser systems for materials processing. Currently, he is heading the Laser Surface Materials Treatment Laboratory of the Laser Materials Processing Division at RRCAT Indore.

Dr. A. A. Shaikh
Professor & Head, Department of Mechanical Engineering,
SVNIT Surat, India

Prof. Shaikh currently works as a professor and Head at the Department of Mechanical Engineering, Sardar Vallabhbhai National Institute of Technology (SVNIT), Surat. His research focuses on developing smart composites and the damage analysis of hybrid composites. He has vast experience in the field of laser assisted manufacturing and materials engineering. In addition to technical expertise, he has also been an effective administrator, having handled quite a few big projects including the world bank sponsored TEQIP projects.



Dr. Vipul Kheraj
Associate Professor
Department of Physics,
SVNIT(SVNIT) Surat, India

Dr. Vipul Kheraj obtained his PhD in Applied Physics from the M S University of Baroda, Vadodara, in 2008, before joining SVNIT, Surat, as Assistant Professor of Physics. Currently he is working as Associate Professor at Department of Physics, SVNIT. His areas of research are thin-films and materials science with an emphasis on optoelectronic materials and devices. Dr. Kheraj is a Fulbright alumnus, being a Fulbright-Nehru Postdoctoral Research Fellowship awardee for 2013-14 at University of Utah, Salt Lake City, USA, to carry out research on cost effective solar cells.