VIU

Venice
International
University

Isola di San Servolo
Venezia - ITALY

July 11 – 18, 2010

2nd International School on

Laser-surface interactions for new materials production: tailoring structure and properties

The purpose of the School is to offer a comprehensive overview on basic principles and relevant applications connected to the irradiation of solids by energetic laser beams. The goal is to explore the use of light in the development of novel materials with emphasis on specific control of their properties at nanometer scale. The field is relatively young and has grown at a very high rate in the last fifteen years, thanks to worldwide research activity. One area of very high interest is the use of lasers in deposition processes; it is possible, for example, to deposit virtually any material, including multi-component compounds, preserving the composition of the ablated target, and generally avoiding post-deposition thermal treatments. In addition, the experimental setup involved in pulsed laser deposition is generally compatible with in situ diagnostics of both the plasma and the growing film. The basic laser-surface interaction mechanisms possible in an ambient atmosphere, either chemically reactive or inert, are a challenge to scientists, while engineers are mostly interested in the characteristics of the deposited materials and in the

possibility to tailor their properties through an appropriate tuning of the deposition parameters.

In addition, lasers can be used to modify materials in a highly controlled fashion; this includes both bulk and surface modification. Examples include production of surface nanostructures as well as nanoparticles (both bulk and surface). These laser-induced changes can strongly influence the optical and electronic properties of the irradiated material. Finally, a wide range of applications and characterization techniques involve understanding on a very basic level the interaction mechanisms. Plasmonics is one blossoming field requiring such knowledge.

Among the hot topics developed in recent years are ultra-short laser pulses to explore electronic excitation in solids and its relaxation with phonons in highly non equilibrium conditions, the synthesis of nanoparticles and their assembling to prepare nanocrystalline films and the deposition of metastable systems.

Well established International Conferences bring together every year many researchers in the field allowing for extensive scientific exchange. Based on the success of the First edition of the School, the Second is now scheduled with the explicit aim to educate doctorate students in the principles of laser-surface interactions especially in connection with the ablation processes and materials modification.

The proposed one-week School will focus on the deep interplay between experimental and theoretical investigations of laser-induced surface phenomena. The topics include laser-surface and -bulk interactions, the role of defects, non-linear absorption phenomena, surface melting, vaporisation, superheating, homogeneous and possibly heterogeneous nucleation, phase explosion and plasma formation, nanosecond and femtosecond laser pulses, film synthesis by pulsed laser deposition, nanoparticle nucleation, growth and assembling of nanocatalysts relevant to renewable energies and to the ambient, the fate of electrons and displaced atoms/ions in excited solids. The classes of considered materials span the entire realm of technological interest and include metals, semiconductors, and wide bandgap insulators. The main experimental techniques to characterize solids and surfaces before, during, and after irradiation, the plasma plume and the deposited film will be addressed. The true interdisciplinary nature of the School will help promoting fruitful interactions between researchers from such diverse fields as solid state and plasma physics and chemistry, materials science, metallurgy, ceramic, and polymer science. We expect junior researchers will particularly profit from the proposed initiative.

The recognised success of the First edition of the School (directed by A. Miotello and P.M. Ossi) encouraged the Scientific Committee to plan the Second edition in the same place and to maintain the same scientific and organisational structure as that of the First edition. The facilities of Venice Intl. University demonstrated to be excellent and S. Servolo island is a beautiful, quiet garden that facilitates positive interaction among participants, yet it is a few minutes far from S. Marco Square and the very centre of Venice with its exciting cultural and recreational life, in the heart of the summer season.

The School is planned for about 50 students. Attention will be given to keep a truly international character of the event, also through a selection of the participants.

The School Directors

C. Boulmer-Leborgne
M. Dinescu
J.T. Dickinson
P.M. Ossi

Organisation issues

To stimulate the scientific interaction between Lecturers and students, the following timetable will be adopted:

9.00 – 10.10 : lecture
10.10 – 10.30 : informal discussion
11.00 – 12.10 : lecture

lunch time

14.30 – 15.40 : lecture
15.40 – 16.00 : informal discussion
16.00 – 17.10 : lecture/ posters
17.20 – 18.30 : lecture/ posters

Each student is asked to bring a poster with recent relevant results of his research activity. All the posters will be exhibited on the first day in the Lecture room and they will be removed at the end of the School.
Poster sessions are scheduled and the best posters will be awarded.

The following **Lectures** will be delivered at the School:

J. Thomas Dickinson
Department of Physics, Washington State University, Pullman, WA, USA
Important issues in laser materials interactions and relevant applications

Koji Sugioka
RIKEN – Advanced Science Institute, Wako, Saitama 351-0198, Japan
Ultrafast Laser Micro and Nano Processing - Fundamentals to Applications

Peter Schaaf
Ilmenau University of Technology, Institute of Materials Engineering and Institute of Micro- and Nanotechnologies, POB 100565, 98684 Ilmenau, Germany
Free Electron Laser and conventional laser treatments for Functional and Innovative Materials and Structures

Chantal Boulmer-Leborgne
GREMI Université d'Orléans, BP6744, Orléans cedex2 France
Plasma created by laser interaction with materials

Marta Castillejo
Instituto de Química Física Rocasolano, CSIC, Serrano 119, 28006 Madrid, Spain
Plasma Diagnostics and Synthesis of Nanostructured Metal Oxides and Semiconductors with ns and fs PLD

Antonio Miotello
Dipartimento di Fisica, Università di Trento I-38100 Povo-Trento, Italy
Ion- or photon- irradiation of targets and selected applications

Leonid V. Zhigilei
Department of Materials Science & Engineering, University of Virginia, Charlottesville, VA USA
Microscopic view of laser-induced structural and phase transformations from atomic-level simulations

Nadezhda M. Bulgakova
Institute of Thermophysics SB RAS, 1 Lavrentyev Ave., 630090 Novosibirsk, Russia
Continuum models of ultrashort laser ablation: overview, advantages, and limitations

Anna Paola Caricato and Armando Luches
Università del Salento, Dipartimento di Fisica, 73100 Lecce, Italy
MAPLE: fundamentals and recent applications

Richard F. Haglund, Jr.
Department of Physics and Astronomy, Vanderbilt University, Nashville, TN USA
Wavelength-selective laser processing of polymers for device applications

Corinne Champeaux
SPCTS UMR 6638 and Université de Limoges/CNRS, 87060 LIMOGES Cedex, France
Synthesis of Thin Films, Clusters and Nanocomposite Materials by Laser Ablation for Telecom and Optic Applications

Douglas B. Chrisey
Department of Material Science and Engineering, Rensselaer Polytechnic Institute, Troy, NY USA
Laser Processing Applied to Biological Systems

Thomas Lippert
Paul Scherrer Institut, 5232 Villigen-PSI, Switzerland
Laser direct writing methods: laser-induced forward transfer (LIFT) and related techniques

Wolfgang Kautek
University of Vienna, Department of Physical Chemistry, Waehringer Strasse 42, A-1090 Vienna, Austria
Lasers in Cultural Heritage: Fundamentals of Paper and Textile Conservation

Carmen N. Afonso
Laser Processing Group, Instituto de Optica, CSIC, Serrano 121, E 28006 Madrid, Spain
Pulsed Laser Deposition: a Route for Controlling Materials in the Nanoscale?

Paolo M. Ossi
Dipartimento di Energia, Politecnico di Milano, via Ponzio 34-3, 20133 Milano Italy
Cluster synthesis in laser-generated plasmas and controlled nanostructure assembling

Maria Dinescu
National Institute for Lasers, Plasma and Radiation Physics, Bucharest, Romania
PLD based techniques for oxides thin films growth: applications to dielectrics, ferroelectrics and multiferroic

David B. Geohegan
Center for Nanophase Materials Sciences, Oak Ridge National Laboratory, U.S.A.
Laser Interactions and Diagnostics to Understand and Control the Synthesis of Novel Materials

Ion Mihailescu
National Institute for Lasers, Plasma and Radiations Physics, Bucharest, Romania
Nanostructured biomaterials thin films synthesized by pulsed laser-assisted methods