

Report on Euromech 257 :
Mechanical Effects induced by Lasers
(Marseilles 6-8 September 1989)

I. GENERAL INFORMATION ON THE SYMPOSIUM

As part of the "European Mechanics Committee" series of events, the Laser-Matter Interaction team of the Marseilles Institute of Fluid Mechanics organized a symposium, 6-8 September 1989, on the mechanical effects on matter created by a laser beam: "Euromech 257 - Mechanical Effects induced by Lasers".

A scientific committee composed of university researchers and professors selected and invited the best French and European specialists working in the field of lasers and their applications, mainly associated with mechanics.

This first symposium organized in the region by the Institut Méditerranéen de Technologie within the Marseilles-Provence Technological Centre at Chateau Gombert brought together specialists in this rapidly-expanding field [from W. Germany (5), U.K. (2), Switzerland (3), U.S.S.R. (1), Australia (1), U.S.A. (1), Italy (1), Bahrain (1) and France (45)].

II. RESEARCH TOPICS DISCUSSED

The work presented at this symposium dealt with experimental, theoretical and numerical studies carried out in the "Laser-Matter" interaction field and particularly the following:

- studies of the phenomena involved in the interaction between intense laser radiation and matter, in both continuous and pulsed operation (thermoacoustic, thermomechanical and hydrodynamic effects etc.);
- studies of applications of high-power CO₂ lasers, excimer lasers, and solid state lasers (analysis of processes involved in laser machining, surface treatment, marking, welding, drilling, and cutting-out).

The study of these fundamental physical phenomena is of great interest to scientists because of the presence of these phenomena in several applications in medicine, industry and defence.

A total of thirty papers were presented, including three general lectures:

"Understanding pulsed-laser ablation of planar solid targets in the low and high intensity limits" by Dr. C.R. Phipps (Los Alamos National Laboratory, U.S.A.); "High-power laser and industrial applications" by Dr. A. Quenzer (DRET/ETGA AT Arcueil) and Dr. M. Gaillard (Laboratoire de Photophysique Moléculaire, Orsay); "Modelling of melt pool shape and of microstructure formation during laser melting of material surfaces".

The first day was devoted to papers particularly concerned with experiments involving interaction between high-power lasers (10^7 to 10^{11} W/cm²) of different wavelengths ($\lambda = 0.25 \mu\text{m}$, $1.06 \mu\text{m}$, $2.8 \mu\text{m}$, $10.6 \mu\text{m}$) with various materials (alloys of aluminium, titanium, graphite, plexiglass, steel etc.).

The results were mainly concerned with the determination of thermal and mechanical coupling, demonstration of the stresses created by laser shocks, measurement of pressures generated on rear surfaces by piezoresistive and piezoelectric gauges, and interaction phenomena in confined or unconfined conditions.

These three work sessions (consisting of 14 papers) were presided and led by interaction specialists: Mr. Creput (DRET/SDR), Mr. Phipps (Los Alamos National Laboratory, U.S.A.) and Mr. Hugenschmidt (Franco-German Research Institute, St. Louis, France).

Interesting ideas were put forward and discussed regarding the use of intense laser shocks and the resulting mechanical impulsion for hardening the surface and bulk of materials or for correcting the trajectory of telecommunications satellites.

The second day was reserved for continuous laser radiation-matter interaction, mainly applied to laser surface treatment with or without addition of powder, and the study of metal melt pools. The results were mainly concerned with boiling phenomena in an absorbent material and melting phenomena with a resulting modification of the surface, the determination of the residual stress fields obtained after surface treatment, and the numerical study of all these processes. Four sessions (consisting of 14 papers) were organized on these research topics and led by Mr. Tosto of the Italian Research Centre in Rome, Mr. Barralis, Professor at the Ecole National des Arts et Métiers at Aix-en-Provence, France, and by Mr. Inglesakis and Mr. Vigliano of the Marseilles Institute of Fluid Mechanics. A general discussion presided by Professor Emmony of Loughborough University closed the discussion.

On Friday September 8th, a one-day conference was organized by Professor Mercier, entitled "Prospects in heart surgery". The participants in the Euromech Symposium interested in medical applications were able to attend the two morning sessions on "Laser applications in heart diseases", which particularly concentrated on the use of excimer lasers for coronary angioplastics.

As regards the participation in this event, it is interesting to note the places of origin of the researchers:

- a) non-French participants came from Stuttgart University (West Germany), Loughborough and Liverpool University of Technology (England), the Rome National Research Centre (Italy), Queensland (Australia), the Federal Polytechnic School of Lausanne (Switzerland), the Los Alamos National Laboratory (U.S.A.), the Franco-German Research Institute (Saint Louis, France), the Bahrain Ministry of Telecommunications and the Moscow Mechanics Institute (U.S.S.R.);
- b) French participants came from various well-known laboratories in the Paris area: the Power Laser Application Laboratory in Arcueil, the High-Power Laser Utilization Laboratory in Palaiseau; from the C.E.A. (Atomic Energy Commission), Aérospatiale, the Délégation Générale pour l'Armement, O.N.E.R.A. (National Aerospace Engineering Research Centre), the Centre for application of high-energy lasers to the transformation of materials in Lyons, the Arts et Métiers School of Engineering in Aix-en-Provence, and from the Institut Méditerranéen de Technologie and the Institute of Fluid Mechanics in Marseilles.

In a region which is particularly active in research in the field of lasers and their applications (within the Eureka "Eurolaser Project" and Brite programmes) as well in the study of laser radiation-materials interaction (the DRET/SDR programmes and the CNRS Research Group programmes for "Treating materials with high-power lasers"), it was important to organize a scientific event of international importance in order to bring together people from universities and industry who are interested in this subject.

III AIMS

The aims of this event were: to make it possible to have in-depth scientific discussions on the above-mentioned topics, to encourage new joint efforts and to facilitate significant technological progress.

We believe that we achieved at least the first two aims.

This event was combined with a commercial exhibition by national and regional companies that are more specifically interested in laser sources and scientific equipment. Among the main exhibitors (see the complete list in the "Book of Abstracts") were the Laboratoire Bard, BM Industries, Deltalab, Quantel, Sopra etc. The "Club Laser de Puissance", an association for the promotion of power laser applications, was present.

IV RESOURCES

In order to be able to organize this event as well as necessary, we required considerable equipment, facilities and financial resources.

The Institut Méditerranéen de Technologie placed all of its facilities and equipment at our disposal: lecture theatre, workrooms, reception rooms, cloakroom, restaurant and cafeteria. All the necessary audio-visual equipment was made available for the lectures (overhead projector, video cassette player, slide projector etc.). In addition, to enable all participants to understand contributions and follow discussions, English/French simultaneous translation was provided.

Several private and public organizations willingly helped in funding the symposium. Here is the list of patrons (in order of financial contribution): Regional Council of Provence-Alpes-Côte d'Azur, DS/DR Department of Research, Engineering and Technology, Aérospatiale Marignane, Industriel Laser, University of Aix-Marseilles II, Marseilles City Council, University Mechanics Association, Marseilles Institute of Fluid Mechanics, and the Laser-Matter Interaction Team.

This symposium required a budget of approximately 150,000 Francs.

We enclose a copy of the book of abstracts, which contains the addresses of the organizations involved, the venue of the symposium, the lists of the local and national authorities that contributed to funding the event, the list of the exhibiting companies, the detailed programme of the symposium, and the title, author and abstract of each contribution.