

Report on the 40th IUVESTA Workshop: *Gas-Phase Cluster Assembly of Nanostructured Materials*, “Ettore Majorana” Foundation & Centre for Scientific Culture, Erice, Italy

Workshop Directors:

Prof. Paolo Milani, Dipartimento di Fisica, Università di Milano, Italy

Prof. Peter H. McMurry, Department of Mechanical Engineering, University of Minnesota, Minneapolis, (USA)

Prof. Giorgio Benedek, Dipartimento di Scienza dei Materiali, Università di Milano Bicocca, Milano, Italy

PURPOSE OF THE WORKSHOP

The ability to synthesize and to manipulate nanoscale building blocks from the gas-phase promises to lead to fundamentally new advances in materials science and engineering and to exciting opportunities for innovation in technology. Cluster beam and aerosol technologies are now being used to produce and assemble nanoparticles. The integration and cross-fertilization of these two approaches, which, to a large extent have evolved independently, will stimulate the development of novel scientific and technological solutions and performances unattainable with other nanotechniques. The aim of this workshop is to bring together both junior and senior scientists belonging to the cluster-beam and the aerosol communities in order to exchange experiences and new ideas, and to favour the establishment of a common language for novel experimental and theoretical approaches.

The goal is to develop integrated methods for the study of nanoparticles produced in the gas-phase in order to identify the critical parameters affecting the synthesis of nanostructured materials and the manufacturing of nanostructured devices.

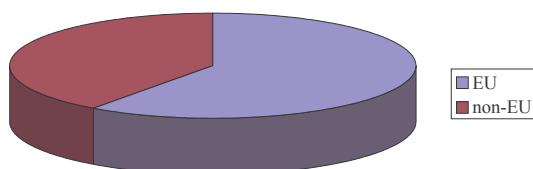
The workshop will focus on the following topics: Nanoparticle design, production, assembling and process technology, Isolated nanoparticle characterization, Cluster-surface interactions, Nanostructured magnetic systems, Nanostructured and Nanocomposite films, Advanced fabrication and characterization techniques, Modelling and simulation of cluster assembling. A Hot Topics session and a Poster session will provide the opportunity for all participants to exchange the results of their work.

The workshop was held between July 26th and August 1st 2003 with almost all of the participants being present for the whole period and attending all the sessions. One of the main objectives of the conference was the merging of two different communities, namely the Aerosol Technology and the Cluster Physics communities on the basis of a common interest for nanostructured materials grown by assembling gas-phase generated nanoparticles. The central idea was that both communities lack of awareness that they are dealing with very similar systems and that is very important to address this point as looking at the same system with different eyes and having an opportunity to share ideas could bring a strong cross-fertilization to both fields. This idea was clearly understood and enthusiastically accepted and shared by a vast majority of the participants as explicated in public remarks and private communications to the organizers.

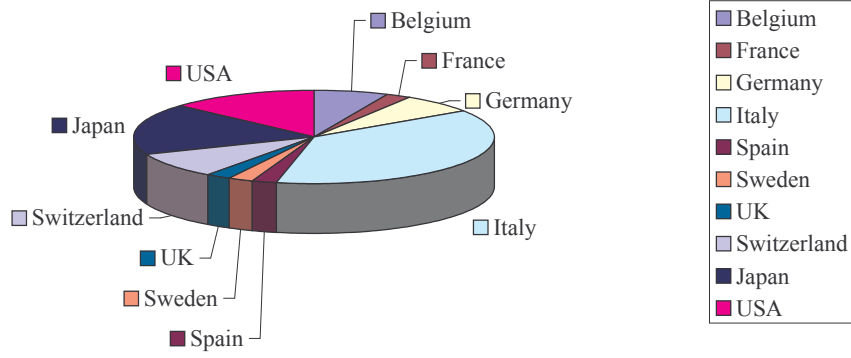
The long time given to oral presentations has proven to be beneficial for the achievement of the highest understanding of the presented materials and results by all the participants, despite of the belonging to different scientific communities. This was also evident from the large number of questions and comments following all the contributions. Time available for discussions was also satisfactorily long enough.

The lunch break was long enough to have short meetings in restricted groups for scientific discussions or to set up plans for future collaboration. The workshop location in a small isolated village was also a good point for the stimulation of such meetings. This was one point appreciated by all the participants.

The composition of the group of participants was only slightly unbalanced by a majority of people coming from EU countries (60%). Non EU participants Were mostly coming from Japan (about 17%), followed by USA (about 13%) and Switzerland (about 9%). Among the EU countries Italy was the most represented.



Participants by country



PROGRAM

26 July Arrival and accomodation

27 July 9.15-9.40 **Presentation of the workshop**

9.40-10.30 **J. Fernandez de la Mora: *Inertial concentration of particle beams*** (keynote lecture)

10.30-11.00 Break

11.00-12.00 **J. Fernandez de la Mora: *Inertial concentration of particle beams*** (keynote lecture)

16.30-17.20 **A. Perez: *Cluster assembling of magnetic nanostructures*** (keynote lecture)

17.20-17.50 Break

17.50-18.40 **A. Perez: *Cluster assembling of magnetic nanostructures*** (keynote lecture)

18.40-19.30 **S. Girshick: *Deposition of nanostructured material by hypersonic plasmas and focused particle beams*** (adv. seminar)

28 July

9.00-9.50 **P. Milani: *Supersonic cluster beam deposition*** (keynote lecture)

9.50-10.20 Break

10.20-11.10 **P. Milani: *Supersonic cluster beam deposition*** (keynote lecture)

11.20-12.30 **J. Akedo: *Aerosol deposition method (ADM) for formation of nanocrystalline films: high speed ceramic coating with fine particle jets and applications to microdevices*** (adv. seminar)

16.00-16.50 **Poster session**

16.50-17.20 Break

17.20-19.00 **Poster session**

29 July

9.00-9.50 **H. Fissan: *Structured deposition of nanoparticles in the gas phase on flat substrates*** (keynote lecture)

9.50-10.20 Break

10.20-11.10 **H. Fissan: *Structured deposition of nanoparticles in the gas phase on flat substrates*** (keynote lecture)

11.30-12.30 **S. Fantechi: *Nanotechnology and nanosciences, knowledge-based multifunctional materials, new production processes and devices: research priorities, instruments for support and possibilities for international co-operation*** (adv. seminar)

Afternoon Excursion

30 July

9.00-9.50 **W. Eberhardt: *Spectroscopic characterization of gas phase and supported nanoparticles*** (keynote lecture)

9.50-10.20 Break

10.20-11.10 **W. Eberhardt: *Spectroscopic characterization of gas phase and supported nanoparticles*** (keynote lecture)

11.30-12.30 **R. Flagan: *Aerosol nanoparticles in microelectronic devices*** (adv. seminar)

16.30-17.20 M. Johnston: *Mass spectrometry of gas phase nanoparticles* (keynote lecture)

17.20-17.50 Break

17.50-18.30 M. Johnston: *Mass spectrometry of gas phase nanoparticles* (keynote lecture)

18.40-19.30 K. Wegner: *Nanoparticle Synthesis in Gas-Phase Systems: Process Design and Scale-up for Metals and Metal Oxides* (adv. seminar)

31 July

9.00-9.50 H. Hahn: *Gas phase chemistry for nanoparticle formation and functionalization* (keynote lecture)

9.50-10.20 Break

10.20-11.10 H. Hahn: *Gas phase chemistry for nanoparticle formation and functionalization* (keynote lecture)

11.20-12.30 M. Hou: *Theory and simulation of nanoparticle assembling* (adv. seminar)

16.00-17.20 Hot topic session (15+5 minute talks)

17.20-17.50 Break

17.50-19.30 Hot topic session (15+5 minute talks)

1 August

9.00-9.50 S. Iannotta: *Supersonic molecular beam epitaxy of organic materials* (adv. seminar)

9.50-10.20 Break

10.20-11.10 R.E. Palmer: *Cluster films for physics, chemistry and biology* (adv. seminar)

11.15-12.00 Concluding remarks

“Hot-Topics” session

SiC thin films from deposition of hyperthermal C60 beams on Silicon

R. Verucchi

IFN-CNR

Povo di Trento, Italy

Preparation and characteristics of core-shell clusters using two cluster sources

K. Sumiyama, R. Katoh, T. Hihara and D.L. Peng

Department of Materials Science and Engineering, Nagoya Institute of Technology, Nagoya, Japan

Fabrication and Device Application of Nanocrystalline Silicon Particles

Shunri Oda

Research Center for Quantum Effect Electronics, Tokyo Institute of Technology

O-okayama, Meguro-ku, Tokyo 152-8552, Japan

Spontaneous Ordering Processes of Silicon Clusters

Synthesized on An Amorphous Carbon Film

Y. Iwata, M. Oki, M. Muto, H. Yamauchi¹, H. Matsuhata¹, S. Okayama¹, and T. Sawada²

Cluster Advanced Nanoprocesses CRT, National Institute of Advanced Industrial Science and Technology (AIST), Tsukuba Central 2, Tsukuba 305-8568, Japan.

¹*Nanoelectronics Research Institute, AIST, Tsukuba Central 2, Tsukuba 305-8568, Japan.*

²*Department of Advanced Material Sciences, Graduate School of Frontier Sciences, The University of Tokyo, 7-3-1 Hongo, Bunkyo, Tokyo 113-8656, Japan.*

Isomer selective spectroscopy on small metal clusters

C. Sieber, W. Harbich, J. Buttet, Ch. Félix

Institut de Physique des Nanostructures, Ecole Polytechnique Fédérale de Lausanne, CH-1015 Lausanne, Switzerland

Au_n clusters deposited on atomically flat surfaces, a scanning tunneling microscopy study

E. Janssens, N. Vandamme, C. Van Haesendonck, and P. Lievens,

Laboratorium voor Vaste-Stoffysica en Magnetisme,

Katholieke Universiteit Leuven, Celestijnenlaan 200D, B-3001 Leuven, Belgium

Carbon Particles as Grown from Matrix Isolated Linear and Cyclic Carbon Clusters

Tomonari Wakabayashi,¹ Hiromichi Kataura,² and Wolfgang Krätschmer³

*Division of Chemistry, Graduate School of Science, Kyoto University, Kyoto 606-8502, Japan*¹

*Department of Physics, Tokyo Metropolitan University, Hachioji, Tokyo 192-0397, Japan*²

*Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, D-69117 Heidelberg, Germany*³

Surface Nanostructuring by Low-Energy Impact of Cluster Ions Formed from Gaseous Precursors

V.N. Popok, S.V. Prasalovich and E.E.B. Campbell

Department of Experimental Physics, Gothenburg University and

Chalmers University of Technology, 41296 Gothenburg, Sweden

LIST OF PARTICIPANTS

J. Akedo ,Advanced Process Technology Group, Institute of Mechanical Systems Engineering, AIST Tsukuba, Japan

S. Baba ,Advanced Process Technology Group, Institute of Mechanical Systems Engineering, AIST Tsukuba, Japan

M. Blomqvist, INFN - Dipartimento di Fisica, Università degli Studi di Milano, Milano Italy

G. Bongiorno, INFN - Dipartimento di Fisica, Università degli Studi di Milano, Milano Italy

T. Caruso, INFN-Dipartimento di Fisica, Università della Calabria, Arcavacata di Rende (CS) Italy

N. Coppede', INFN- CNR Istituto di Fotonica e Nanotecnologie, 38050 Povo (TN) Italy

F. Di Fonzo, Dipartimento di Ingegneria Nucleare, Politecnico di Milano, Milano, Italy

W. Eberhardt, BESSY m.b.H., Wiss. Geschäftsführung, 12489 Berlin Germany

F. Ernst, Particle Technology Laboratory, Department of Mechanical and Process Engineering, ETH Zurich, Switzerland

S. Fantechi, European Commission, DG RTD / G.4, B-1049 Brussels Belgium

D. Farias, D.pto de Física de la Materia Condensada, C-3, Universidad Autónoma de Madrid 28049 Madrid Spain

C. Felix, Institut de Physique des Nanostructures, EPFL, CH-1015 Lausanne Switzerland

J. Fernandèz de la Mora, Yale University, Mechanical Engineering Department New Haven, USA

H. Fissan, Electr. Dept. / Process- and Aerosol Technology, Gerhard-Mercator University Duisburg, Duisburg Germany

R. Flagan, California Institute of Technology 210-41 1200 E. California Blvd., Pasadena, USA

S. Gibilisco, Dipartimento di Fisica, Università di Catania, Catania Italy

S. Girshick, Dept. Mechanical and Industrial Engineering, Chemical Engineering and Materials Science, University of Minnesota, Minneapolis, MN 55455 USA

H. Hahn, Thin Films Division, Technical University Darmstadt, Institute of Materials Science, Darmstadt Germany

T. Hihara, Department of Materials Science and Engineering, Nagoya Institute of Technology, Japan

M. Hou, Physique des Solides Irradiés, CP 234, Université Libre de Bruxelles, Brussels Belgium

S. Iannotta, INFN- CNR Istituto di Fotonica e Nanotecnologie, 38050 Povo (TN) Italy

Y. Iwata, Cluster Advanced Nanoprocesses CRT, AIST Tsukuba, Japan

E. Janssens, Laboratorium voor Vaste-Stoffysica en Magnetisme, Katholieke Universiteit Leuven Leuven Belgium

M. Johnston, Department of Chemistry and Biochemistry, University of Delaware Newark, USA

M. Lebedev National Institute of Advanced Industrial Science & Technology, Tsukuba Japan

C. Lenardi, Istituto di Fisiologia Generale e Chimica Biologica, Università di Milano, Italy
R. Mukherjee, High Temperature and Plasma Laboratory, Department of Mechanical Engineering, University of Minnesota, Minneapolis, MN 55455 USA

S. Oda, Research Center for Quantum Effect Electronics, Tokyo Institute of Technology, Tokyo 152-8552 Japan

R. E. Palmer, School of Physics and Astronomy, The University of Birmingham Birmingham, UK

A. Perez, Laboratoire de Physique de la Matière Condensée et Nanostructures, Université Claude Bernard - Lyon1, Villeurbanne Cedex France

P. Piseri, INFN - Dipartimento di Fisica, Università degli Studi di Milano, Italy

V. Popok, Department of Experimental Physics, Gothenburg University and Chalmers University of Technology, Gothenburg Sweden

L. Ravagnan, INFN - Dipartimento di Fisica, Università degli Studi di Milano, Italy

P. Russo, Dipartimento di Fisica, Università di Catania, Italy

E. Salis, Dipartimento di Ingegneria Nucleare, Politecnico di Milano, Italy

A. Scalisi, Nanostructured Thin Film Laboratory, Università di Catania, Italy

L. Seminara, Institut de Physique des Nanostructures (IPN), EPFL, Lausanne Switzerland

F. Siviero, Dipartimento di Fisica, Università degli Studi di Milano, Italy

K. Sumiyama, Department of Materials Science and Engineering, Nagoya Institute of Technology Nagoya 466-8555 Japan

R. Verrucchi, INFN- CNR Istituto di Fotonica e Nanotecnologie, 38050 Povo (TN) Italy

T. Wakabayashi, Division of Chemistry, Graduate School of Science, Kyoto University, Kyoto, Japan

K. Wegner, Particle Technology Laboratory, Department of Mechanical and Process Engineering, ETH Zurich, Switzerland