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Introductory Remarks on the Shockwaves Cluster

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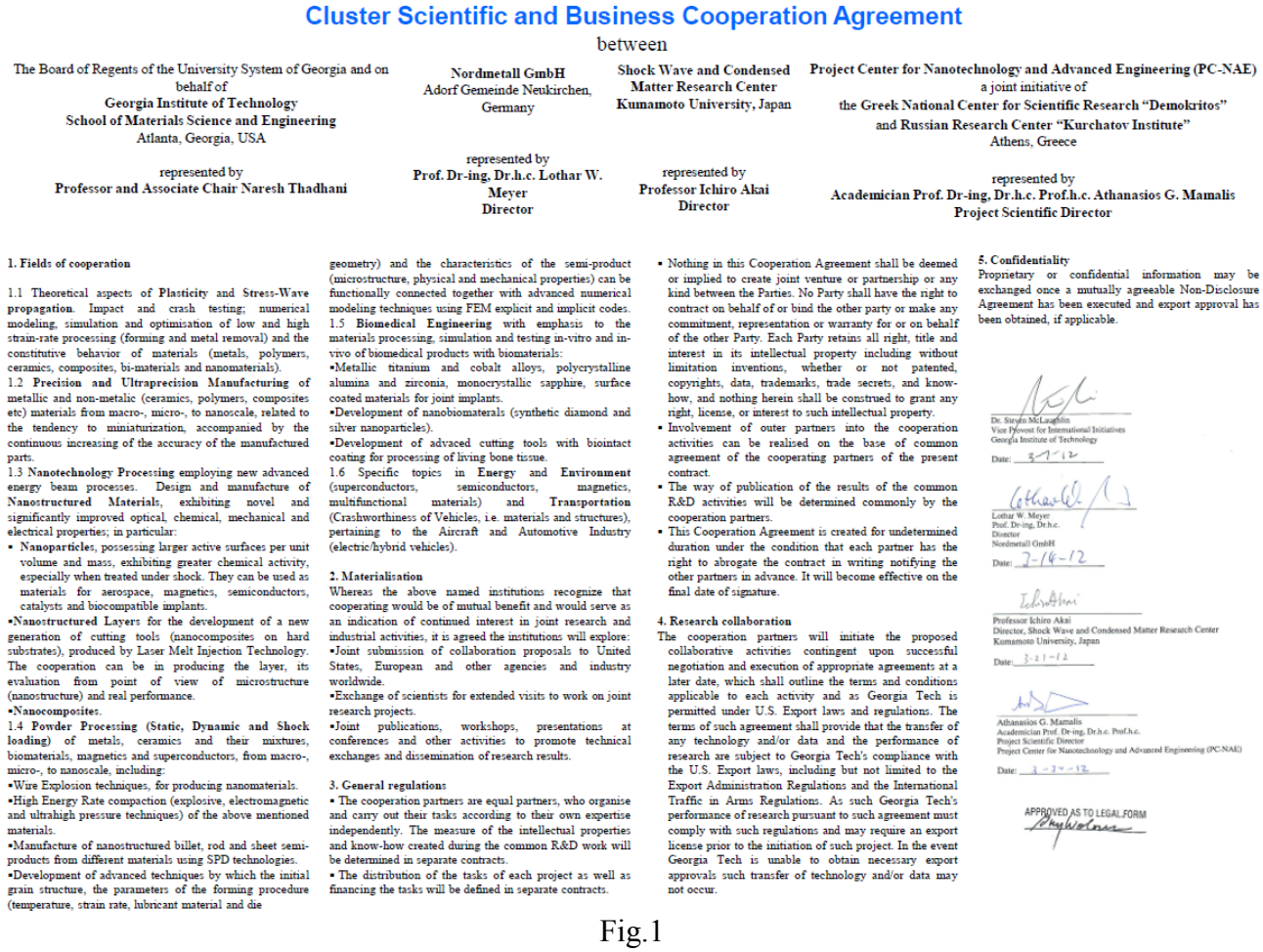
Keyword: Shockwaves Cluster.

The *Shockwaves Cluster*, involving cooperation between Greece, Russia, USA, Germany, Japan, China, Hungary, Ukraine and Turkey, has been established almost five years ago with the MoU, see Fig.1, signed by the *Georgia Institute of Technology*, USA, the *Nordmetall GmbH*, Germany, *the Shock Wave and Condensed Matter Research Center of Kumamoto University*, Japan and the *Project Center for Nanotechnology and Advanced Engineering (PC-NAE)*, Greece, a joint initiative of the *Greek National Center for Scientific Research "Demokritos"* and the *Russian Research Center "Kurchatov Institute*", with the *PC-NAE* representing also my Ukrainian and Hungarian partners, namely the *Bakul Institute for Superhard Materials* in Kiev and the *S-Metalltech and the Obuda University* in Budapest, respectively, as well as my longstanding, more than 30 years, links with the *Lavrentyev Institute of Hydrodynamics* in Novosibirsk and the *Kirensky Institute of Physics* in Krasnoyarsk in Siberia, Russia. Four years ago, the *Beijing Institute of Technology* with *its State Key Laboratory of Explosion Science and Technology* in China and, last year, the *Izmir Institute of Technology*, Turkey, joint the Group. Furthermore, it has to be pointed out the involvement in the activities of the Group of *Prof. Fernand Marquis,* an expert in this field, and my longstanding, over 20 years, collaborator, from the EXPLOMET Conferences in Los Alamos in New Mexico in the US in the middle 90's to his distinguished positions in the University of South Dakota, the Monterey Naval School and the San Diego State University in the USA.



Cluster Scientific and Business Cooperation Agreement

between

The Board of Regents of the University System of Georgia and on behalf of
Georgia Institute of Technology
School of Materials Science and Engineering
Atlanta, Georgia, USA

represented by
Professor and Associate Chair Naresh Thadhani

Nordmetall GmbH
Adorf Gemeinde Neukirchen, Germany

represented by
Prof. Dr-ing, Dr.h.c. Lothar W. Meyer
Director

Shock Wave and Condensed Matter Research Center
Kumamoto University, Japan

represented by
Professor Ichiro Akai
Director

Project Center for Nanotechnology and Advanced Engineering (PC-NAE)
a joint initiative of
the Greek National Center for Scientific Research "Demokritos"
and Russian Research Center "Kurchatov Institute"
Athens, Greece

represented by
Academician Prof. Dr-ing, Dr.h.c. Prof.h.c. Athanasios G. Mamalis
Project Scientific Director

1. Fields of cooperation

1.1 Theoretical aspects of **Plasticity** and **Stress-Wave propagation**. Impact and crash testing; numerical modeling, simulation and optimisation of low and high strain-rate processing (forming and metal removal) and the constitutive behavior of materials (metals, polymers, ceramics, composites, bi-materials and nanomaterials).
1.2 **Precision and Ultraprecision Manufacturing** of metallic and non-metalic (ceramics, polymers, composites etc) materials from macro-, micro-, to nanoscale, related to the tendency to miniaturization, accompanied by the continuous increasing of the accuracy of the manufactured parts.
1.3 **Nanotechnology Processing** employing new advanced energy beam processes. Design and manufacture of **Nanostructured Materials**, exhibiting novel and significantly improved optical, chemical, mechanical and electrical properties; in particular:
- **Nanoparticles**, possessing larger active surfaces per unit volume and mass, exhibiting greater chemical activity, especially when treated under shock. They can be used as materials for aerospace, magnetics, semiconductors, catalysts and biocompatible implants.
- **Nanostructured Layers** for the development of a new generation of cutting tools (nanocomposites on hard substrates), produced by Laser Melt Injection Technology. The cooperation can be in producing the layer, its evaluation from point of view of microstructure (nanostructure) and real performance.
- **Nanocomposites**.

1.4 **Powder Processing (Static, Dynamic and Shock loading)** of metals, ceramics and their mixtures, biomaterials, magnetics and superconductors, from macro-, micro-, to nanoscale, including:
- Wire Explosion techniques, for producing nanomaterials.
- High Energy Rate compaction (explosive, electromagnetic and ultrahigh pressure techniques) of the above mentioned materials.
- Manufacture of nanostructured billet, rod and sheet semi-products from different materials using SPD technologies.
- Development of advanced techniques by which the initial grain structure, the parameters of the forming procedure (temperature, strain rate, lubricant material and die geometry) and the characteristics of the semi-product (microstructure, physical and mechanical properties) can be functionally connected together with advanced numerical modeling techniques using FEM explicit and implicit codes.

1.5 **Biomedical Engineering** with emphasis to the materials processing, simulation and testing in-vitro and in-vivo of biomedical products with biomaterials:
- Metallic titanium and cobalt alloys, polycrystalline alumina and zirconia, monocrystallic sapphire, surface coated materials for joint implants.
- Development of nanobiomaterals (synthetic diamond and silver nanoparticles).
- Development of advaced cutting tools with biointact coating for processing of living bone tissue.

1.6 Specific topics in **Energy** and **Environment** (superconductors, semiconductors, magnetics, multifunctional materials) and **Transportation** (Crashworthiness of Vehicles, i.e. materials and structures), pertaining to the Aircraft and Automotive Industry (electric/hybrid vehicles).

2. Materialisation

Whereas the above named institutions recognize that cooperating would be of mutual benefit and would serve as an indication of continued interest in joint research and industrial activities, it is agreed the institutions will explore:
- Joint submission of collaboration proposals to United States, European and other agencies and industry worldwide.
- Exchange of scientists for extended visits to work on joint research projects.
- Joint publications, workshops, presentations at conferences and other activities to promote technical exchanges and dissemination of research results.

3. General regulations

- The cooperation partners are equal partners, who organise and carry out their tasks according to their own expertise independently. The measure of the intellectual properties and know-how created during the common R&D work will be determined in separate contracts.
- The distribution of the tasks of each project as well as financing the tasks will be defined in separate contracts.
- Nothing in this Cooperation Agreement shall be deemed or implied to create joint venture or partnership or any kind between the Parties. No Party shall have the right to contract on behalf of or bind the other party or make any commitment, representation or warranty for or on behalf of the other Party. Each Party retains all right, title and interest in its intellectual property including without limitation inventions, whether or not patented, copyrights, data, trademarks, trade secrets, and know-how, and nothing herein shall be construed to grant any right, license, or interest to such intellectual property.
- Involvement of outer partners into the cooperation activities can be realised on the base of common agreement of the cooperating partners of the present contract.
- The way of publication of the results of the common R&D activities will be determined commonly by the cooperation partners.
- This Cooperation Agreement is created for undetermined duration under the condition that each partner has the right to abrogate the contract in writing notifying the other partners in advance. It will become effective on the final date of signature.

4. Research collaboration

The cooperation partners will initiate the proposed collaborative activities contingent upon successful negotiation and execution of appropriate agreements at a later date, which shall outline the terms and conditions applicable to each activity and as Georgia Tech is permitted under U.S. Export laws and regulations. The terms of such agreement shall provide that the transfer of any technology and/or data and the performance of research are subject to Georgia Tech's compliance with the U.S. Export laws, including but not limited to the Export Administration Regulations and the International Traffic in Arms Regulations. As such Georgia Tech's performance of research pursuant to such agreement must comply with such regulations and may require an export license prior to the initiation of such project. In the event Georgia Tech is unable to obtain necessary export approvals such transfer of technology and/or data may not occur.

5. Confidentiality

Proprietary or confidential information may be exchanged once a mutually agreeable Non-Disclosure Agreement has been executed and export approval has been obtained, if applicable.

Dr. Steven McLaughlin
Vice Provost for International Initiatives
Georgia Institute of Technology
Date: 3-21-12

Lothar W. Meyer
Prof. Dr-ing, Dr.h.c.
Director
Nordmetall GmbH
Date: 3-16-12

Professor Ichiro Akai
Director, Shock Wave and Condensed Matter Research Center
Kumamoto University, Japan
Date: 3-21-12

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Academician Prof. Dr-ing, Dr.h.c. Prof.h.c.
Project Scientific Director
Project Center for Nanotechnology and Advanced Engineering (PC-NAE)
Date: 3-27-12

APPROVED AS TO LEGAL FORM

Fig.1

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The *Cluster* provides the opportunity to specialists from Universities, Research Centers and Industry of various countries worldwide to establish cooperation and to share knowledge and experience in the broad area of the *advanced manufacturing of advanced materials and structures*, mainly associated with *high strain-rate phenomena* and *treatment under shock (explosives, electromagnetics, ballistics (projectiles hitting targets), hypervelocity impact, high temperature/high pressure techniques* and so on), focusing in particular, on the relevant Industrial sectors: *precision / ultraprecision manufacturing, nanotechnology, powder production and processing, biomedical engineering, transport (*mainly *aerospace), energy, environment,* as well as *safety* and *defense.*