


FIRST WORKSHOP  
ON  
INDUSTRIAL APPLICATIONS OF SHOCK  
PROCESSING OF POWDERS

CENTER FOR EXPLOSIVES  
TECHNOLOGY RESEARCH

JUNE 1-3, 1988



MACEY CENTER  
NEW MEXICO INSTITUTE OF MINING  
AND TECHNOLOGY  
SOCORRO, NEW MEXICO 87801

ORGANIZERS  
M.A. MEYERS AND N.N. THADHANI

WORKSHOP ON  
INDUSTRIAL APPLICATIONS OF SHOCK  
PROCESSING OF POWDERS

OBJECTIVE OF WORKSHOP

The objective of this workshop is to apprise the technical and scientific community of the potential of shock processing of materials and of the progress made in the past five years. New approaches have been developed and new potential applications have surfaced. Shock processing is a unique method for the consolidation of ceramic powders (diamond, boron nitride, oxide superconductors) and rapidly solidified crystalline and amorphous powders, and for the synthesis of novel materials (gallium arsenide, diamond and intermetallic compounds).

Shock processing of powders involves a range of techniques utilizing the extremely rapid deposition of energy in the powders by shock waves. The shock waves can be produced either by explosives or by high-velocity impact. Processes that are being developed using these concepts are:

- (a) Dynamic compaction in which consolidation of the powder occurs due to the shock energy being preferentially deposited at particle surfaces during the passage of shock waves;
- (b) Shock-enhanced sintering in which the dynamically consolidated compact is statically compressed and heated in a normal sintering procedure to produce the final product;

- (c) Shock conditioning in which the powder is shocked in any convenient geometry, remilled and then sintered;
- (d) Shock-induced chemical synthesis in which a compound is formed from a powder mixture during the passage of the shock wave and is at the same time consolidated;
- (e) Shock-induced transformations in which novel structures with desirable properties can be formed under the high-pressure regime.
- (f) Chemically-assisted shock consolidation which is a combination of shock-induced chemical synthesis and shock consolidation. In this case, inert powders are mixed together with an exothermically reacting elemental mixture, and the passage of a shock wave induces a reaction between the elemental powders, promoting at the same time bonding between the initially inert and difficult-to-consolidate materials.

It is now time to vigorously pursue industrial involvement in the implementation of these processes. One of the primary goals of this workshop is to create an industrial awareness of the potential and limitations of the shock processing technology. Lectures will be given by a group of recognized authorities and by CETR members. The third day of the workshop will be devoted to laboratory demonstrations and to the performance of actual explosive events in the new CETR field laboratories.

WORKSHOP PROGRAM

Wednesday, June 1, 1988

- 7:00 - 7:45 a.m. Breakfast at Macey Center  
 7:45 - 8:15 a.m. Registration  
 8:15 - 8:20 a.m. L.H. Lattman, President, New Mexico  
 Tech, Welcome Address  
 8:20 - 8:45 a.m. P.-A. Persson, Director, CETR,  
 "Overview of CETR and its Involvement"

GENERAL SESSION

- 8:45 - 9:30 a.m. L.E. Murr, Oregon Graduate Center,  
 "Explosive (Shock-Wave) Fabrication  
 of Superconducting Engineered Material  
 Systems"  
 9:30 - 10:15 a.m. A. Sawaoka, Tokyo Institute of Technology,  
 "Shock Processing Research in Japan"  
 10:15 - 10:30 a.m. --- Coffee Break ---  
 10:30 - 11:15 a.m. R. Prummer, Fraunhofer Institut für Werkstoffmechanik, Germany, "Shock Compaction  
 Research in Europe"  
 11:15 - 12:00 p.m. M. Wilkins, Dynamic Compaction Int.,  
 "Shock Consolidation: Prospects"  
 12:00 - 1:15 p.m. Lunch - Macey Center  
 1:30 - 2:15 p.m. W. Sharpe, EF Industries, Colorado, "Explosive  
 Metalworking at EFI: Status and  
 Prospects"  
 2:15 - 3:00 p.m. D. Brasher, Northwest Technical Industries,  
 "Explosive Metalworking at NTI"  
 3:00 - 3:15 p.m. --- Coffee Break ---  
 3:15 - 4:00 p.m. A. Niker, Ballistic Research Laboratory,  
 "Shock Consolidation of Combustion  
 Synthesized Ceramics"  
 4:00 - 5:00 p.m. Discussion  
 6:30 - 8:30 p.m. Dinner at Val Verde Steak House

Thursday, June 2, 1988

7:00 - 8:00 a.m. Breakfast at Macey Center

CERAMICS SESSION

- 8:00 - 8:35 a.m. T.J. Ahrens, CalTech, "Shock Consoli-  
 dation of Ceramics using Gas Gun"  
 8:35 - 9:10 a.m. O.R. Bergmann, DuPont, "Industrial  
 Processes and Applications of Shock  
 Synthesis of Diamond and Explosive  
 Bonding of Metals".  
 9:10 - 9:45 a.m. Z. Iqbal, Allied-Signal, Morristown, New  
 Jersey, "Shock Consolidation of  
 Ceramic Superconductors"  
 9:45 - 10:20 a.m. A. Miller, CETR, New Mexico Tech,  
 "Shock Synthesis of GaAs & Oxide  
 Superconductors"  
 10:20 - 10:30 a.m. --- Coffee Break ---  
 10:30 - 11:05 a.m. K.P. Staudhammer, Los Alamos  
 National Labs., "Superconductor  
 Consolidation"  
 11:05 - 11:40 a.m. V. Linse, Battelle-Columbus Institute,  
 "Shock Consolidation at High  
 Temperatures"  
 11:40 - 12:10 p.m. Discussions  
 12:10 - 1:15 p.m. Lunch - Macey Center

Thursday June 2, 1988 -(continued)

RAPIDLY SOLIDIFIED MATERIALS SESSION

- 1:15 - 1:50 p.m. G.E. Korth, EG&G, Idaho, "Shock  
 Compaction of RSP Materials"  
 1:50 - 2:25 p.m. T. Vreeland, Jr., CalTech, "Shock  
 Consolidation and Property Studies of  
 RSP Alloy Powders"  
 2:25 - 3:00 p.m. M.A. Meyers, CETR, New Mexico  
 Tech, "Dynamic Compaction of  
 Intermetallic Alloys"  
 3:00 - 3:10 p.m. --- Coffee Break ---  
 3:10 - 3:45 p.m. D. Raybould, Allied-Signal, "Shock  
 Processing of Amorphous Materials"  
 3:45 - 4:20 p.m. O.T. Inal, New Mexico Tech., "Shock  
 Consolidation of Amorphous Alloys"  
 4:20 - 5:00 p.m. Discussions  
 5:00 - 8:00 p.m. No host bar and barbecue at Macey  
 Center

Friday, June 3, 1988

- 7:30 - 8:30 a.m. Breakfast at Macey Center  
 8:30 - 10:30 a.m. Tour of CETR field laboratories and  
 shock consolidation demonstration  
 experiments at CETR Eagle firing site  
 10:30 - 12:30 p.m. Round table discussions coordinated  
 by R.A. Graham and M.A. Myers  
 2:00 - 4:00 p.m. Briefing to CETR Technical Advisory  
 Committee (CLOSED SESSION)

## GENERAL INFORMATION

### REGISTRATION

Workshop registration fees are \$350 and include technical sessions, meals (Wednesday, Thursday, and Friday morning), visit to CETR field laboratories and explosive compaction demonstration experiments (Friday). Advance registration is recommended. Please use the registration form or call 505-835-5130. For additional technical information call Dr. Marc A. Meyers (505-835-5831) or Dr. Naresh N. Thadhani (505-835-5177).

### LOCATION AND FACILITY

The Workshop will be conducted at Macey Center, New Mexico Institute of Mining and Technology, in Socorro. Socorro is located in Central New Mexico (75 miles South of Albuquerque on I-25) and is accessible through the Albuquerque International Airport served by all major airlines. Major car rental agencies are also represented at the Albuquerque Airport. Shuttle service to Socorro is also available, and reservations can be made by calling the Socorro Shuttle Service at 505-835-0040, or workshop registration office. The shuttle runs four services from the airport to Socorro at the following times: 8:00 a.m., 12:30, 5:00, 10:30 p.m.. The shuttle service will be supplemented by New Mexico Tech transportation on Tuesday afternoon (May 31st): 3:00 p.m., 8:00 p.m.

The Center for Explosives Technology Research (CETR) was established in July 1983 at the New Mexico Institute of Mining and Technology, with the objective of promoting economic activity through the development of new technologies utilizing explosive shock waves. CETR is a center for technical excellence within the Rio Grande Research Corridor in New Mexico, funded by seed money from the state.

Research at CETR is generally focussed on high-strain-rate technology for materials synthesis, development of energetic materials, and explosive processes of special importance in industrial applications.

CETR has constructed and operates a modern firing research laboratory and is presently constructing an explosives processing facility. Upon completion it will be capable of making virtually any shape of explosive component from any formulation. The Eagle field laboratory is a one-square mile site in the mountainous terrain five miles west of the main campus. This laboratory consists of the Big Eagle firing site and buried bunker for high-speed photography and electronic recording of explosive events. This site is capable of handling up to 500 lbs. of high-explosive charges. Another laboratory (little Eagle) consists of an enclosed concrete firing chamber with adjacent flash X-rays, optical, and electronic recording laboratory for explosives up to 15 lbs.

The Center for Explosives Technology Research is a branch of the Research and Development Division of New Mexico Tech, an educational research institute with a 100-year tradition of quality.

The New Mexico Tech campus offers a championship 18-hole golf course, a swimming pool, and a mineral museum featuring over 10,000 specimens from New Mexico and around the world.

A walking tour of Socorro features historic buildings, including the old Spanish mission and historic houses dating from the mining rush times in the 1880's. The famous Bosque del Apache National Wildlife Refuge, a bird and animal sanctuary, is located 16 miles south of the town. The Very Large Array (VLA), largest radio telescope facility in the world, is located in the San Augustin Plains, 50 miles west of Socorro. Tours to the Bosque del Apache and the VLA will be arranged for Friday afternoon at minimal charges.

Economic and comfortable accommodations are available in close proximity to the campus. Motel reservations can be made directly or by indicating on the registration form. A block of rooms for the workshop attendees has been reserved at the following motels:

Best Western Golden Manor Motel (505-835-0230)  
Single - \$32.00; Double - \$34.00

El Camino Motel (505-835-1500)  
Single - \$32.77; Double - \$36.05

Vagabond Motel (505-835-0276)  
Single - \$28.54; Double - \$32.78

Transportation to and from these motels will be provided.