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
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 fur Werkstoffmechanik, Germany, "Shock Compaction Research in Europe"
11:15 - 12:00 p.m. M. Wilkins, Dynamic Compaction Intl., "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. Niler, 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

CEMERIC SESSION

8:00 - 8:35 a.m. T. J. Ahrens, CalTech, "Shock Consolidation 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

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. Ansh, 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)
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 focused 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.