2nd ICNDST Highlights Developments in Diamond Research

The Second International Conference on the New Diamond Science and Technology (ICNDST-2) was held September 23-27, 1990 in Washington, DC. Nearly 500 attendees from around the world exchanged information on the latest developments in diamond research, which spanned not only the new emerging materials science and technologies of vapor-deposited diamond, but also high-pressure synthetic and natural diamond technologies. This multidisciplinary, biennial, and international conference has emerged as the premier conference in the new diamond field.

The term "new diamond" was coined by the Japan New Diamond Forum, which sponsorsed the first ICNDST in October 1988 in Tokyo. The term was chosen to denote a new era in diamond science and technology, created by the ability to deposit diamond from a low-pressure gas at commercially feasible rates over large areas.

ICNDST-2 was sponsored by the Materials Research Society and run as a standalone conference in cooperation with the various ICNDST committees and international advisers. The overall conference chair was Rustum Roy of Pennsylvania State University. He was assisted by Russell Messier, also of Pennsylvania State University, who served as organizing committee co-chair and treasurer; Jeffrey T. Glass of North Carolina State University, who served as program committee chair; and James E. Butler of the Naval Research Lab, who chaired the local arrangements committee.

The meeting's technical program consisted of 20 invited papers and 160 contributed papers (50 oral and 110 poster), with no parallel sessions. The nature of this research area, combined with the workshop, contributed to a highly attended and interactive meeting.

ICNDST-2 had the distinct pleasure of having Boris V. Derjaguin, one of the pioneers of diamond deposition and other areas of physical chemistry, as its plenary speaker. Derjaguin, from the U.S.S.R. Academy of Science's Institute of Physical Chemistry in Moscow, provided reflections on the development of this field and his views on its future direction.

New Results

Several new results were reported and discussed at the conference:

- Rice University's D.E. Patterson, B.J. Bai, C.J. Chu, R.W. Hauge, and J.L. Margrave announced a new halogen-chemistry approach for activating the gas phase chemistry and leading to the deposition of metastable diamond. This preliminary result, reported for the first time, adds a new thermal process for gas phase activation. The paper created hope for a new approach to coating large areas with complex shapes at a low cost.
- K. Okana described work by a group at Tokai University in which phosphorous was used in gas phase doping during diamond deposition, resulting in a p-n junction diode (few attempts to make n-type diamond have been successful until now). Although the diode characteristics are far from ideal, the results promise a much wider range of microelectronic devices if the dopant efficiency, carrier mobility, etc. can be improved.
- Johan Prins, University of Witwatersrand, presented a paper involving the high temperature, high fluence carbon ion implantation into copper crystals, leading subsequently to a layer of diamond growth. The result offers both a new chemistry for diamond stabilization and growth, and the possibility of a heteroepitaxial substrate. However, many of these initially exciting results will need further study to confirm their scientific and technological potential.
- The announcement in July 1990 by General Electric Corporation and Wayne State University of a dramatic 50% increase in the thermal conductivity at room temperature of isotopically enriched ^{12}C diamond (natural diamond contains 1.1% of ^{13}C impurity) came under the first-time scrutiny of a scientific meeting. The papers by Roger Pryor and Robert Thomas of Wayne State, and Tom Anthonly and Robert Banholzer of GE, were greeted with much anticipation. Several late-entry poster papers also delved into this topic. Dan Morelli, GM Research Labs, showed alternative thermal conductivity measurements on the GE-grown isotopically pure diamond bulk crystals; and Russell Seitz of Entropy Conversion, presented in more detail the prediction of enhanced thermal conductivity in isotopically pure diamond. He had made the prediction previously in a 1975 patent and a postdeadline presentation at one of the early diamond meetings (February 1987 at MIT Lincoln Laboratory). A highly visible prediction of the phenomenon also appeared in Tom Clancy's novel, *The Cardinal in the Kremlin*.

A conference wrap-up session, led by Max Yoder of the Office of Naval Research, summarized not only the new findings described above, but also key issues confronting the diamond science and technology community.

Other Highlights

The conference reception and banquet, held at the Smithsonian Institution's Museum of Natural History, provided both visual highlights and an opportunity for international recognition. With the main rotunda as the center of the reception, the attendees and guests had access to the extraordinary national mineral collection, including the famous Hope Diamond.

Kenneth Yale, chief of staff of the Office of Science Technology and Policy (OSTP), extended official greetings from Allan Bromley, science adviser to the President and head of OSTP. Yoichiro Sato, from the National Institute for Research in Inorganic Materials in Tsukuba, conveyed greetings from the chairman of the Japan New Diamond Forum, Shinroku Saito. Boris V. Spitsyn of the Institute of Physical Chemistry in Moscow, another one of the pioneers of diamond deposition, extended his greetings in the form of a symbolic emblem presented to Rustum Roy as a gesture of friendship and international cooperation in the pursuit of diamond research.

The concluding address was presented by Tom Clancy, author of a number of popular techno-thrillers, which are acclaimed for their technical detail and accuracy.

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