Gemological Digests

WORLD'S LARGEST MANUFACTURED DIAMOND PRODUCED BY UTAH SCIENTISTS

(Ed. note: The development reported in the following digest may prove more important in industrial diamond technology than the original synthesis of diamond grit. Polycrystalline synthetic diamond – a synthetic carbonado – that can be shaped to suit the task as well as having a much longer useful life, is a truly revolutionary discovery.)

The largest known manufactured diamond in the world – a 20-carat cylinder larger than a toothpaste cap – has been produced by a team of Utah scientists after years of intensive research in a secluded laboratory here.

Dr. H. Tracy Hall, who in 1954 became the first man to accomplish a confirmed synthesis of diamond, unveiled the unpolished gray-black stone at his tree-cloistered Megadiamond Corporation laboratory on the outskirts of Provo last fall.

Hall, president of Megadiamond and Distinguished Professor at nearby Brigham Young University, said the process breakthrough that made possible creation of the material called *Megadiamond* (trademark), is more significant than his initial discovery of how to make diamond. "It is the harbinger," Hall said, "of an exciting new era in industrial-diamond technology."

The soft-spoken scientist said Megadiamond of 100 carats is within the firm's capability, and that commercial production "can begin immediately."

Dr. Harvey Fletcher, former director of the Bell Research Laboratory, called the achievement one of "far-reaching significance," and Governor Calvin L. Rampton issued the following statement:

"The creation of a multicarat diamond by man is, without question, a technological breakthrough of the highest order. We are justly proud that this event has been achieved in Utah – proud of our Utah industry and proud of the extraordinary talent that chooses Utah as a place for man, for industry, for movement forward. Utah salutes Dr. Tracy Hall and Megadiamond Corporation."

Elaborating on the achievement, Hall explained that the 20-carat stone is the result of a first-of-its-kind process for bonding diamond particles into large, usable polycrystalline diamonds.

"The closest thing in nature to Megadiamond is carbonado, a polycrystalline diamond mined chiefly in Brazil," Hall said. "Carbonado is extremely tough, but because of its many-crystalled structure it is not easily shaped. You can't cleave it accurately – you have to grind it to the shape you want. Since only diamond will cut diamond, this is an expensive process – analogous to cutting a board with a wooden saw."

"On the other hand," Hall continued, "Megadiamond is comparable to carbonado in toughness but can be formed directly in virtually any desired shape: wedges, points, flat plates, pierced parts, rollers, spirals. This formability feature eliminates the time-consuming grinding process and opens up limitless possibilities, particularly in view of the fact that industrial-diamond use is increasing 10% a year, twice the annual industrial growth rate."

Hall predicted that wherever industry needs large-sized diamonds for wear or abrasive applications or for high resistance to deformation, "Megadiamond will be part of the action."

Some immediate applications the firm sees for Megadiamond are wire-drawing dies, drills, chisels, thread guides, saws, blades, specialized machining tools, and grinding wheels and grinding-wheel dressers. (*Figure 1* shows a 20- and a 16-carat grinding-wheel dresser. *Figure 2* shows, from left to right, a 1-carat mounted dresser, a 12-carat dresser with a central hole, a 3.30-carat cabochon mounted in a man's ring, and, front center, a 1.50-carat faceted Megadiamond.)

"But we're looking at a good many other intriguing possibilities down the road a bit," Hall said.

Dr. Bill J. Pope, who collaborated with Hall on the project with Dr. M. Duane Horton, said that Megadiamond has far greater strength than existing industrial-diamond materials, which are held together with plastic or metal-bonding agents. "That's another reason we're confident we're going to have real impact on the country's $100 million-plus annual diamond-tool industry," Pope said.

Pope, Megadiamond's Executive Vice President and former Chairman

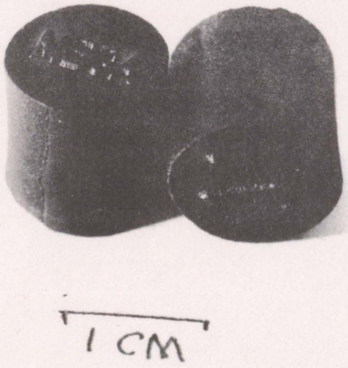

Figure 1.

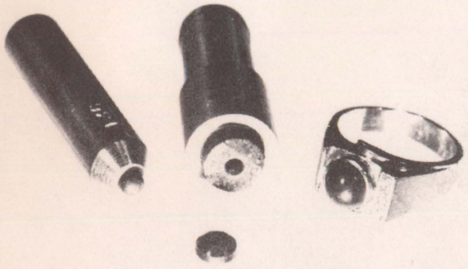

Figure 2.

of the Chemical Engineering Department at BYU, detailed two other significant advantages of Megadiamond: "Natural diamonds, used in many industrial applications, are single crystals; consequently, they cleave along certain planes. This means that the angle of attack at which a natural-diamond tool contacts the work is critical and must be held within narrow limits to avoid chipping the diamond. Because Megadiamond is a many-crystalled material and the crystallites are randomly oriented, uniform hardness is achieved and the angle of attack is much less critical."

"Additionally," Pope went on, "the Megadiamond process will enable industry to put diamond particles and powder back together. This is of tremendous importance, because most processes involving cutting and processing with diamond produce by-product diamond chips and powder. Now we can reassemble these pieces, thereby reducing manufacturing costs and conserving existing diamond supplies."

Asked why Megadiamond doesn't look like engagement-ring diamond, Dr. Horton, Vice President and Secretary-Treasurer, said that "something happens in the bonding process – we're not certain just what – that absorbs all light in the diamond material. We're conducting further research on this phenomenon."

Horton added, however, that "carat-wise, about 80% of the diamond market is industrial; consequently, that's the area of first priority."

Although the time required to produce Megadiamond is company proprietary, Horton said, "there is no question about Megadiamond's economic feasibility."

The manufacturing process consists of subjecting natural or synthetic diamond particles to ultra-high pressure and temperature in Megadiamond's six-ram, high-pressure press. "The press rams have enough thrust," Horton said, "to lift 36 100-ton locomotives off the ground simultaneously. As for temperature, it's higher than that required to melt steel."

The story of Hall's press has drama all its own. Hall first synthesized diamond on December 16, 1954, six years after joining General Electric's Research Laboratory at Schenectady, New York, and three years after beginning research specifically on diamond synthesis.

Synthesizing diamond was a twofold achievement: Hall not only delineated the precise chemistry of diamond formation and determined how to reproduce it, but he also designed and directed construction of the "belt" – a high-pressure device light years ahead of its time in high-pressure technology and principally responsible for the 600 high-pressure research laboratories in operation world-wide today.

Because GE's proprietary interest kept Hall from using the belt after he left the company in 1955, he designed a totally different high-pressure apparatus to continue his research. He accomplished this in 1957, but it took a top-brass directive from the Pentagon to lift federal secrecy orders and clear the way for Hall to use his own invention.

Megadiamond Corporation was organized in 1966 by Hall, Pope and Horton. The Corporation is housed in a 2000-square-foot block building in north Provo. The structure includes executive offices, laboratory, press room, shop area and store room.

The company draws its name from the fact that it is conducting research and development, as well as manufacturing operations, at pressures of more than one million pounds per square inch (*mega* denoting million).

In addition to its work with diamond, the firm is actively engaged in research across the entire spectrum of high-pressure/high-temperature technology.