Foreigners fear superconductor club is beyond their means

Tokyo & Washington

At the opening ceremony of Japan's International Superconductivity Technology Center at a Tokyo hotel in January, only a handful of Westerners were present. And it seems that the centre is going to stay that way. For, despite an open invitation to join, very few foreign companies think that the million-dollar membership fee makes it worthwhile.

The centre was established by private industry at the urging of the Ministry of International Trade and Industry (MITI) to carry out research and disseminate information on the new high-temperature superconductors. From the outset, international cooperation was invited, and there was much talk in Japan of avoiding the brutal competition that soured US-Japan relations over semi-conductors.

Full membership of the consortium is expensive. To use the centre's research laboratory requires a down-payment of ¥100 million (\$800,000) and an annual fee of ¥12 million (\$100,000). And that is just a start: then come research costs and, for foreign firms, the cost of sending staff and providing them with local back-up.

For a smaller annual fee of ¥2 million (\$16,000), companies get access to an information service, a newsletter and international symposia.

The laboratory should be complete in the autumn and will be headed by Professor Shoji Tanaka, recently retired from Tokyo University. Although more than 100 Japanese companies, including banks and security companies, are subscribing to the information service and 45 have joined the laboratory, foreign companies are not so keen. IBM Japan, Rockwell International and Du Pont, all of which have Japanese subsidiaries, will join the information service, according to a MITI official. But no foreign company has agreed to join the research laboratory.

Professor Roland Schmitt, president of Rensselaer Polytechnic Institute, New York, and chairman of the National Science Board, stresses that Japanese officials should not be over-hasty in blaming US companies for lack of enthusiasm for international cooperation. He points out that the original invitation to join the centre came with just a four-page explanation. "Any company research director would have been out of his mind to send an \$800,000 dollar cheque based on the information given", he says.

There are many opportunities to spend money on superconductor research in the United States, he points out, and there is a proven value in projects at US laboratories. And multi-company co-operative research institutes — a rarity

even in Japan — are not, he believes, such an important part of the Japanese success story that US firms must rush to join in.

Westinghouse Research and Development's Professor John Hulm says that his company has made no decision yet. He worries about the economics of joining the research centre and about whether researchers who do not speak Japanese could really hope to participate fully. Unfortunately, experts in high-temperature superconductors who also speak Japanese are rare! Du Pont's Dr Alan Lauder says his company will join the information centre and "hasn't precluded" joining the research centre.

Organizers of the centre are putting on a brave face. Risaburo Nezu of MITI's Agency of Industrial Science and Technology says that seven or eight foreign companies, including American Telephone and Telegraph (AT&T), are "thinking" about joining the laboratory. Nezu is also very

encouraged by a meeting he had two weeks ago with officials of Britain's Department of Trade and Industry. He felt strongly that Britain wants to cooperate and he is very "hopeful" that British companies will participate in the centre.

Tanaka appreciates US difficulties. He sees many problems to overcome, particularly in relation to patents and licences. According to Nezu, patents taken out in the centre's research laboratory will be jointly owned by the centre and the member companies which belong to the laboratory, but this must be examined "from the legal point of view".

At an international conference on superconductivity held in the United States at the end of February, Tanaka says, he approached one researcher after another without success. British researchers, on the other hand, have shown a very positive response, according to Nezu. And both he and Tanaka see a good possibility that two or three researchers will come to the laboratory from Britain. But a tiny fraction of foreign researchers will hardly justify calling the centre "international".

David Swinbanks & Alun Anderson

High-critical-temperature superconductor made from glass

Tokyo

High-critical-temperature superconducting glass? Not quite. But Japanese researchers at the Technological University of Nagaoka have succeeded in making glass

Making superconducting glass.

from the ingredients of various bismuth-based high-temperature superconductors. And subsequent annealing at high temperature (820°C) converts the glass into a superconductor. The development could be used in the manufacture of very fine superconducting wires.

The glasses are prepared by melting various combinations of bismuth, calcium, strontium, aluminium, lead and copper oxides at 1,150°C. The melts are then quenched by pouring onto an iron plate and quickly pressing them into a slab.

Samples of $\text{Bi}_{1.5}\text{CaSrCu}_x$ and $\text{Bi}_{1.5}\text{Ca}_{1-x}\text{SrCu}_x\text{O}_y$ prepared by the technique exhibit perfect glass behaviour — they are completely amorphous and when slowly heated between 400 and 500°C show an endothermic glass transition followed by exothermic crystallization. Melt-quenched samples containing lead or aluminium are also glass-like, but X-ray diffraction reveals small crystalline peaks.

Similar melt-quenching methods have already been applied to the preparation of high- T_c yttrium-based copper oxides but the melt-quenched yttrium ceramics are microcrystalline (for example, see *Nature* **330**, 511; 1987). This is the first report of glass, and the Nagaoka researchers call their new materials "high- T_c superconducting glass-ceramics".

The Nagaoka team has found that rapid cooling in liquid nitrogen after annealing produces superconductors with the highest transition temperatures. The highest T_c obtained so far is 78 K for $\text{BiAl}_{0.5}\text{CaSrCu}_x\text{O}_y$.

The great advantage of the glass ceramics is that they can easily be formed into various shapes. And Professor Kazumasu Matusita, who heads the research, says that it should be possible to draw the glass out into very fine wires using the same technology that has been developed to make optical fibres. Details of the glass preparation method will be published in the *Japanese Journal of Applied Physics*.

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