European Networks Focus on Advanced Materials

The European Networks on Advanced Materials were established in 1987 to enhance scientific and technical cooperation between research teams from different countries. With the assistance of industrial and public institutions and with the support of the Council of Europe and the Commission of European Communities, the European Materials Research Society is continuing to develop these networks. Eleven networks have established programs, and three are in the initial stages of development (see table).

The February issue of the MRS BULLETIN carried an article (p. 58) introducing the European Networks on Advanced Materials. The article in this issue inaugurates a periodic series that will focus on the philosophies, aims and activities of the separate networks as described by their chairmen. Featured this month are Network 1 on Laser Photochemistry and Network 2 on Solid State Ionics.

A brochure detailing all the networks is available from: P. Siffert, Chairman, European Materials Research Society, Centre de Recherches Nucleaires, 23, rue de Loess, F-67037, Strasbourg, France; telephone 88 28 65 43; fax 88 28 09 90.

Network 1—Laser Photochemistry

Chairmen: K.L. Kompa, Max Planck Institut für Quantenoptik, Garching, West Germany; E.F. Krimmel, Institut für Kernphysik, J.W. Goethe Universitä t, Frankfurt, West Germany.

Classic materials and conventional techniques for producing materials will (in certain cases) no longer meet the standards of future technical developments. New techniques to produce, structure and shape advanced materials have to be investigated and developed and are obvious topics for future industrial evolution.

Particular attention should be directed to such progressive fields as microelectronics, telecommunications, engineering ceramics, compounds, light metals, transport systems, high temperature superconductors, and polymers.

Laser chemistry, with its overlapping features can make a substantial contribution to this challenge...and so the establishment of the Network on Laser Photochemistry.

Laser photochemistry focuses on techniques that use directed light beams for materials processing. The essential features of laser chemical processes are their short reaction periods, high reaction rates, and optimum range of process energy. Many experimental results obtained in American, Japanese or European laboratories are very promising and demonstrate this method's unique power.

Scientists cooperating in the European Network on Laser Photochemistry are active in the following topics:

- Production of structured multilayers of electronic materials (also in the nanometer range) for novel microelectronic or optoelectronic devices;
- Production of new materials containing components that do not intermix as they would by conventional means such as diffusion at high temperatures;
- Production of glassy metals and alloys or high temperature superconducting ceramics; and
- Machining of high technology ceramics of high brittleness without causing mechanical defects.

The network is arranged on two levels to facilitate maximum interaction: (1) an intercommunicative level (workshops, summer schools, conferences), organized by E-MRS, on which all interested individuals or institutions can participate, and (2) a research level on which industrial and university laboratories can establish close cooperation.

Emphasis is being placed on the flexibility of the program in order to establish optimum harmony in the results obtained in ongoing work as well as future expectations. Relevant findings are presented and discussed in the intercommunicative level and will be rapidly published in proceedings or reports.

It has become clear during the course of this network that as the field has expanded and developed, the network should also reflect these changes. It is expected, therefore, that in the near future, new people will be included and the problems of surface and interface reactions with beam processing will be addressed.

Currently, the 36 laboratories participating in the Network on Laser Photochemistry are in France, Greece, Ireland, Italy, the Netherlands, Spain, West Germany, and the United Kingdom.

K.L. Kompa

E-MRS Networks on Advanced Materials

Network Number	Theme	Group Leaders
1	Laser chemistry	K.L. Kompa, E.F. Krimmel (FRG)
2	Solid state ionics	M. Balkanski (France)
3	Modeling of solidification	H. Fredriksson (Sweden)
4	Metastable alloy production	J. Bottiger, B. Stritzker, M. von Allmen (Denmark, FRG, Switzerland)
5	Microanalysis of semiconductors	E. Sirtl, A. Cullis (FRG, UK)
6	High energy ion implantation	G.G. Bentini (Italy)
7	II-VI Te-based semiconductors	R. Triboulet (France)
8	Biomaterials	D. Muster (France)
9	Gallium arsenide	H.S. Rupprecht, W. Wettling (FRG)
10	Metal matrix composites	G. Chadwick (UK)
11	Electroactive polymers	M. Zerbi (Italy)

Emerging Networks: Superconducting ceramics, Materials under microgravity, InP and related III-IV materials.

Network 2—Solid State Ionics

Chairman: M. Balkanski, Laboratoire de Physique des Solides, Université Pierre et Marie Curie, Paris, France.

The production, storage, and distribution of energy is one of the main concerns of modern industry and society. The development of solid state ionics promises the creation of new types of electrical power sources and energy conversion and storage systems, which would have an important impact on industry and which are needed for outer space applications.

More effective energy storage systems are particularly important for applications where the energy sources are intermittent, such as solar energy and wind power. In some cases cost is critical, and in others it is efficiency. Of special interest is the possible use of nonaqueous battery systems based on alkali metals, which could store appreciably greater amounts of energy per unit weight or volume than achievable with present technology.

One growing trend that demands greater performance involves self-contained power sources for pocket calculators, cameras, watches, toys, and electrical tools, and the like. Especially important is the need for improved power sources for implantable biomedical devices.

Microbatteries are also being pursued for use in microelectronic devices, to provide both basic power and backups for power failures. This may lead to significant changes in the design and construction of semiconductor-based technology for a wide range of applications.

Research by the Network on Solid State Ionics will aim at establishing basic knowledge and technological processes, and at developing materials which are fast ion conductors or mixed conductors. Three technological categories are being considered:

- Solid state microbatteries and high energy density batteries, mainly based on the use of lithium;
- Solid state ionic sensors; and
- Electrochromic displays or smart windows.

Depending on the application, several types of configurations can be envisioned for batteries with alkali metal negative electrodes. In all these cases solid electrolytes and mixed conductors may play an important role. In some cases the solid electrolyte may be a crystalline inorganic superionic conductor; in others the material may have an amorphous or glassy structure. One direction of current interest is the use of either amorphous or crystalline organic polymers as electrolytes.

Another direction attracting much attention is new electrode materials for high performance battery applications. Some of these materials, which often are mixed ionic and electronic conductors, undergo insertion reactions. When the material has a layered-type crystal structure, such reactions are often described using the term "intercalation." Some of these materials have crystalline structures while others are amorphous or glassy.

Solid state ionic sensors also employ solid electrolytes, often in thin film or layer form. Currently, oxygen sensors based on the use of solid electrolytes are being manufactured in great numbers for use in vehicles and steel making, which require operation at elevated temperatures. Efforts are under way to expand the use of this technology in new directions and toward operation at lower temperatures.

The possibility of developing practical information displays or electrically controllable windows based on the use of electrochromic materials is also attracting increased attention. The key element in this type of technology is a mixed conductor whose optical properties can be changed by varying its chemical composition. Fast mixed conductors based on either amorphous or crystalline transition metal oxides such as WO_3, into which either protons or alkali metal ions can be readily and reversibly inserted, are leading candidates for this type of application.

Fifteen laboratories from England, France, Greece, Italy, Spain, and West Germany currently participate in this network.

M. Balkanski