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DEVELOPMENT OF ELECTRONIC MATERIALS IN INDIA:
STATUS AND PROPOSALS FOR CO-OPERATION*

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I. ROLE OF MATERIALS IN ELECTRONICS TECHNOLOGY AND TECHNOLOGY DEVELOPMENT TRENDS

Electronics is all pervasive activity which has applications in communications, pollution control, energy saving, modernising industry to improve economic benefits, etc. as also, in improving standard of living. Another distinguishing feature is an astonishing break-throughs achieved in its relatively short history, in optimising the performance and cost of materials, components and systems, through exploitation of materials properties and phenomenon. A deeper understanding of intimate relationship between the processing, composition and structure of materials on one hand together with their properties, functions and applications, on the other, i.e., the interactive knowledge coupling between materials and the end products, has been increasing. The electronics end product can be thought of a compact system of intricate and highly inter-dependent assembly of materials, each carefully selected to play a definitive role in an organised manner. In this context, not only the materials like silicon, gallium arsenide, ferrites, liquid crystals, semiconductors, etc. are important but processed metals, chemicals, polymers, ceramics, etc. are also important.

The gap between the advanced and the conventional technology has been widening and new innovative developments are becoming the competitive trend for survival in the context of global environment. The quantum of investment required is increasing both for developing new technologies as well as transferring these into new product lines. Carrying out advance R&D totally by one industrial unit is becoming costly and financing them through internal resources is getting more difficult.

Though the long term and short term benefits of technology development may vary for industrialized and developing countries, the need to have intensive R&D activity has been ever increasing. It is known that the value addition arising out of the technology input is increasing over the recent years and the contribution of basic raw materials though critical, has become negligible in terms of the cost of the end product.

II. STATUS OF DEVELOPMENT, CONSTRAINTS FOR GROWTH AND APPROACH FOR TECHNOLOGY DEVELOPMENT.

The electronics industry in India, started around consumer products manufactured under protectionist environment with import of capital goods, materials and technology. The products were generally selected based on the local demand to meet industrial and consumer needs. With limited efforts for absorption and upgrading of the imported technology, and inability of local R&D to provide adequate and fast results to meet the growing needs, the gap, between technology available internationally and that available locally, increased significantly. Efforts to develop next generation technology remained limited. Most of the funds for R&D come from Govt., as the Industry, with low production volumes, is not able to provide adequate resources for materials technology.

The price of technology from advanced country is high. This makes developing country, in many cases, to buy the finished product rather than the technology, because of the commercial considerations arising out of low initial demand. Thus the developing countries find it difficult to be a leader in technology at any time to come. Thus the process of transfer of resources to advanced countries for purchase of products as well

as technology continues. Moreover, continued availability of resources for advanced technology, attracts scientists and technologists to developed countries, effectively depleting the scientific talent in the developing countries. These issues and their long range implications are important.

To achieve quantitative results in the context of national socio-economic policies, initially, the main emphasis could be on bridging the existing technology gaps and to explore possibilities of exploiting natural resources and skills for maximum economic advantage. An appropriate responsive organisational structure, as a core of all activities would be essential. Since major funding is coming from Govt. a centralised structure could be acceptable

In order to make the programme effective, the objectives and goals should be clear and quantitatively definable. The long term and short term goals are arrived at based on the availability of the resources and expected returns on the investments. The respective roles of nodal agency, industry/pilot plant laboratories, national laboratories and academic institutions are clear. To ensure technology development efforts by the industry, necessary policy instruments are evolved to give fiscal and physical incentives to industry.

III. INDIAN PROGRAMME ON DEVELOPMENT OF ELECTRONICS MATERIALS

The focus of Government efforts on developing electronics materials sector is mainly on generating industrial output to meet the critical needs and to ensure higher returns on the investments being made. While deciding the priority, importance

is being given to criteria such as economic viability, export potential, criticality to industrial growth, etc. Engineering development efforts to transfer the available R&D results into production know-how, etc. is being given maximum support and involvement of industry, including private sector, has been ensured during all stages of planning, implementation and monitoring of the technology development programme.

The nodal agency, Deptt. of Electronics (DOE), is co-ordinating with industry on the one hand and the R&D laboratories on the other. The technology development programme on electronics materials, in addition to industry promotion activities, has two components, namely, sponsoring projects at appropriate agencies and departmental programme to establish technologies at pilot scale for important materials. The sponsored projects are co-ordinated under Electronics Materials Development Council (EMDC) at a national level and the departmental programme is implemented as an autonomous scientific society which runs laboratories under Centre for Materials for Electronics Technology (C-MET).

The objectives of the programme of EMDC are to develop a strong R&D base for electronics materials and to meet the future needs of the country. The members of the Council and its Working Groups are experts in electronics materials drawn from industry and R&D. Representatives from Scientific Departments, Finance and Planning Commission are also members. The scope of the projects covers, R&D, pilot plant activities, manpower development, setting up of characterisation facilities, etc.

The main objectives of C-MET are to establish technology on pilot scale for a range of electronics materials for transfer to industry for commercialization, to ensure limited supply of critical materials for R&D and industry, and to establish a national data base on electronics materials. In the first phase three laboratories have been set up at Hyderabad (for ultrapure metals and related products), Pune (for thick film materials, chemicals and polymers), and Thrissur (for ceramics and rare earth materials). A co-ordinating group is located at Delhi looks after overall aspects relating to policy, technology transfer, finance and administration, as also, houses the data bank. A few more laboratories to cover other areas would be set up in the second phase.

Thus, the Deptt. of Electronics has a total plan for the development of electronics materials. It has established a mechanism to plan, implement and monitor the programme with involvement of industry and academia. The activities, cover enhancing industrial production for local consumption and exports, taking up/supporting research in advance materials and converting R&D results into techno-economically viable products. Its comprehensiveness, therefore, is unique. India can share the experience with other developing countries.

IV. PROPOSALS FOR IMPROVING TECHNOLOGY COOPERATION BETWEEN DEVELOPED AND DEVELOPING COUNTRIES.

The major constraint for the developing countries to catch up with the industrialised world and to reap the benefits from the new materials age, is availability of advanced technology for processing, production and applications of advance materials. UNIDO has initiated several projects to assist the developing countries. It is possible to improve their impact, by selecting

areas where economic and technological benefits are generated in a shorter time frame, and the economic returns so generated are invested further to achieve multiplier effect. Some proposals, for consideration in this context are :

- a) A study assisted by UNIDO/UNDP is taken by the developing country to identify projects based on selection criteria, which may include, potential of natural resources, investments already made in terms of production, technology development, research, etc., the technological gaps to be bridged, overall input to output intensity factors etc. C-MET can undertake this task for India.
- b) The broad recommendations emerging out of the above exercise are further discussed with individual developing country and the participating countries in the form of 'Intensive Workshops' to prepare action plan for follow up by the concerned host developing country. The task of implementation can be assigned to a dedicated agency in the developing country. For example, as regards electronics materials in India such an agency, viz. C-MET, exists, having necessary science, engineering and managerial expertise.
- c) India has natural resources for advanced electronics materials for global market eg. gallium, tantalum, rare earths, iron oxide, mica, etc. and also a well formulated programme for the area. Adequate industrial infrastructure in chemical, metallurgical and other fields exists. The technical expertise already available covers wide variety of disciplines, basic to tackle the problems associated with the materials technology, if advance technology inputs are available. Thus, India is one amongst a very few developing countries, which can enter the advanced materials age to play

a role in the global scenario and can take a lead role in establishing a 'Centre of Excellence in Electronics Materials' in collaboration with UNIDO/UNDP. Other developing countries can also join the activity. The scope of this Centre would include carrying out detailed studies for the developing countries, identifying areas for systematic building up technological strength, providing training to scientists from developing countries in materials processing, as their applications and also technology transfer. The scope of programme would also involve development and transfer of technologies tailored to meet the needs of the respective developing country. In addition, this Centre can provide consultancy services covering research, development, characterisation of materials, etc.

V. CONCLUSIONS AND RECOMMENDATIONS

The significance of new technologies and applications of advance materials in electronics and everyday life system is increasing. Because of non-availability of appropriate advance technologies, the natural resources and skills are not exploited for full economic benefits to the developing country. Govt. of India is implementing a well formulated comprehensive programme for electronics materials production and R&D to achieve a quantum jump in this direction and can share the experience with other developing countries and help in formulating appropriate programmes for them. UNIDO is assisting to narrow the technology gap, as well as working actively in technology transfer from the advance countries to developing countries. It can help to accelerate the progress of the Indian efforts through project support in well selected areas as well as setting up a Centre of Excellence. These activities in turn would serve the developing countries in their efforts.