Nanobiotechnologies and nanomedicine: Organizational and market challenges in a technology convergence scenario

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In a European context of knowledge-based and information driven society, Spain is evolving to a new economic model for sustainable growth. Among all the research priorities and market opportunities, findings suggest that the commercialization of the nanobiotechnologies developed in Spain is a big issue for technology transfer and innovation managers. A subsequent analysis suggests that Spanish universities and science and technology parks are key players in the area of nanobiotechnology transfer and innovation, and thus they have a fundamental role in fostering the innovation and creativity that are emerging from the social and industrial nano-revolution, with special attention being paid to a the nanomedicine sector.

The atomically precise manufacturing (APM) is expected to provide a wide array of practical and profitable technologies and products as research and development in nanotechnology proceeds. Indeed, nanotechnology is widely predicted to drive the next "industrial revolution" [1], one referred to as "the materials age" and which is the result of a sequence of preliminary revolutions in electronics, ICT and biotechnology [2].

Scientific papers and patents in the nanotechnology sector have grown exponentially over the last two decades. Products based on nanotechnology are already in use and analysts expect markets to grow by hundreds of billions of euros during the present decade. After a long R+D incubation period, several industrial segments are already emerging as early adopters of nanotech-enabled products and findings suggest that the Bio&Health market is among the most challenging ones during the next years.

In this context, nanobiotechnology is a rapidly advancing area of scientific and technological opportunity that provides advances into the food industry, energy, environment and medicine. This new discipline is placed at the interface of physical and biological sciences and has the potential of revolutionizing medicine when the tools, ideas and materials of nanoscience and biology are combined (Figure 1).

In the nanomedicine case, there is a wide range of technologies that can be applied to medical devices, materials, procedures, and treatment modalities. A closer look at nanomedicine introduces emerging nanomedical techniques such as nanosurgery, tissue engineering, nanoparticle-enabled diagnostics, and targeted drug delivery. According to an expert group of the European Medicines Evaluation Agency (EMEA), the majority of current commercial applications of nanotechnology to medicine are devoted to drug delivery. On the other hand, novel applications of nanotechnology include tissue replacement, transport across biological barriers, remote control of nanoprobes, integrated implantable sensory nanoelectronic systems and multifunctional chemical structures for targeting of disease.

Nanotechnology implies a new approach to research strategies and it is needed to enhance co-location and coordination, as well to improve integration between public and private partners, encouraging multidisciplinary training programmes and working teams and helping to identify new solutions and products [3]. Bozeman [4] points out that the arrival of a radically new technology generates new knowledge dynamics, new roles of the institutions and new technological and industrial opportunities. Clustering in nanotechnology has interesting dynamics and the success and failure of a cluster to be stimulated is in part related to the degree of success in agglomeration of technology platforms [5]. As a result, academics and policy makers are investigating the performance of inventors working in the emerging field of nano science and technology, as well as the effectiveness of different institutional regimes [6]. Actually, the scientific and technical challenges of working at this scale are huge, and

future progress depends not only on the sharing of knowledge about tools and techniques but also on the exchange of expertise regarding the atomic and molecular interactions along this new scientific frontier. Furthermore, nanomanipulation equipment is relatively scarce, and cooperation is thus crucial at this time. This can be achieved by sharing equipment and knowledge in networks and virtual teams, as well as by the setting up of cooperative, multidisciplinary and public-private ventures such as Minatec (Grenoble) in France or MESA+ (Twente) in The Netherlands. In Barcelona, for instance, there is a process of clustering and alliances focused on the nanomedicine niche as a strategy to "catch up" the windows of opportunity currently offered by biotechnology and nanotechnology.

In summary, a survey about nanobiotechnology commercialization is given laying emphasis on nanomedicine and its Spanish context, in which research and medical applications are heavily funded by governments and private sector. The performance of the Spanish universities and science and technology parks is considered in terms of efficiency and competitiveness enhancing ecosystems for private-public partnerships in the field of nanobiotechnologies and improving their market position in the global knowledge-based economy.

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Figures:

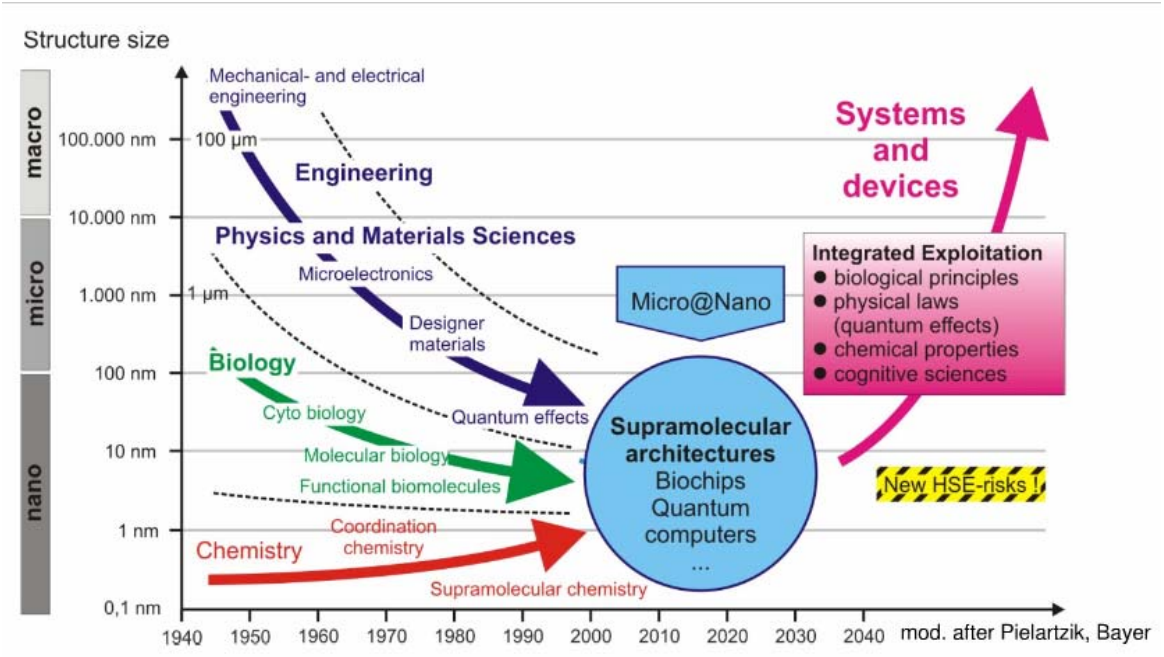

Figure 1. Convergence of technologies and revolutionary performance of the nanotechnology [2].