Report on the Special Miniworkshop „nano&Management"

International Winterschool on Electronic Properties of Novel Materials (IWEPNM 2013), Kirchberg/Tirol, Austria, 5th March 2013

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- funding strategies;
- start-up companies;
- demonstrators;
- prototypes;
- pilot-plants

Abstract

This is a short report on a special workshop on matters "around" science, held during the Kirchberg Winterschool 2013 on Electronic Properties of Novel Materials. The topics discussed are patents, experiences of small start-up companies, funding and patenting strategies of large research institutes (like CRANN in Ireland and Fraunhofer Society in Germany) and success stories of cooperation between American university institutes and industrial partners (from invention over demonstrator, prototype, and pilot plant to production lines). (© 2013 WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim)

1 Introduction Success in science is not only a matter of careful experiments and brilliant calculations, planning and management are just as important: Where will I get samples from, who can help me with specialized instrumentation, how can I organize a powerful team, when should I file a patent and when should I publish, what sources of funding are available? To discuss questions of this kind, we had organized a special miniworkshop during the 2013 Winterschool IWEPNM at Kirchberg/Tirol, Austria.

2 Patents Michael Schmid (Wiesbaden, Germany) presented an overview on patenting, including a guideline to patent protection. His presentation will be published as a separate paper in these proceedings. We will review the other presentations at the miniworkshop and the discussion. Certainly, most scientists would like to do both: patenting and publishing. Not only the publication list, also the patent list, is an important part of our CV and helps getting jobs and funding. In Siegmar's personal career, his latest appointment, a WCU project in Korea, was a teaching position, but the patent list was crucial to get the project accepted. As Michael has pointed out, in many cases, one can do both, patent and publish. While the patent attorney is working on the patent application the scientist is writing the text of the publication, and by the time the publication appears the patent has already been filed. The discussion revealed that some organizations have strict patent rules and long waiting lines. In particular, if the scientist wants to present a recent discovery at a conference, the organization's patent administration office might not yet have given clearance. Some offices even want to see the full text of the presentation prior to permitting disclosure. For some of us this would not work, because we usually keep modifying our talks until the last night, or we even modify them during the presentation itself. Here a compromise might be that scientist and office agree on general lines, not on individual figures and words. A similar problem exists in con-

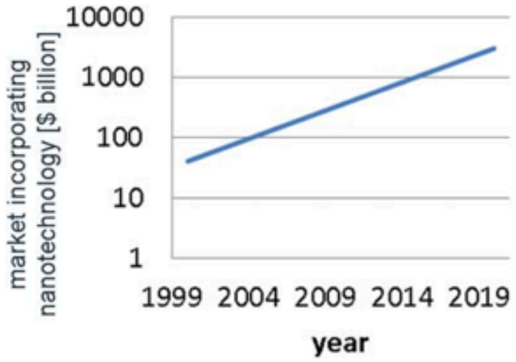

Figure 1 Development of the worldwide market incorporating nanotechnology (M.C. Roco, W. Bainbridge: "Societal implications of nanoscience and nanotechnology", Boston, Springer, 2001).

sortium agreements, which many national and European funding agencies require to be signed. Siegmar remembers a situation, when he was working at a Max Planck Institute and had won a government-funded cooperation project with one of the largest German industrial companies. The lawyers just could not agree on the intellectual property paragraph, and they kept negotiating even when the scientists had already finished the project (The issue was that the Max Planck Society might lose the "private non profit" tax privilege if they agreed to what the company thought was their minimum requirement).

Figure 1 shows the development of the worldwide market for nanotechnology. As can be seen, the market potential for nanotechnology-based products is huge and constantly growing. Participation in the market could be by producing and selling nanotechnology products. However, research institutes usually have no possibility of producing goods by themselves. But by patenting and licensing participation in the global market is possible for these research institutes. Figure 2 depicts the number of publications on nanotechnology in the Science Citation Index. This number is rapidly increasing and underlines the realization of the presence of the above mentioned nanotechnology market by many research institutes. Further, the number of patent applications filed each year (not shown) is following

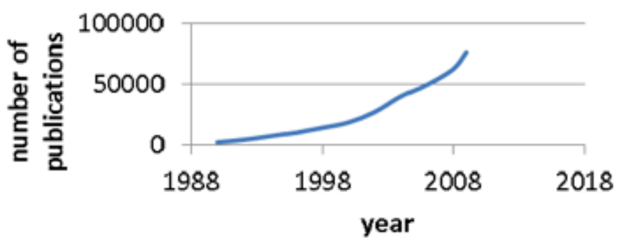

Figure 2 Number of publications on nanotechnology in the Science Citation Index (R. Siegel, E. Hu, M. C. Roco, Eds. "Nanostructure science and technology", Washington DC, National Science and Technology Council, published by Kluwer, currently Springer, 1999).

this trend in publications. Thus, this is an indication that in real life patenting (and potentially licensing) products is a practicable way of participation of research institutes in the global market.

3 Start-ups Viera Skákalová (Bratislava, Slovakia) reported on her experience with a small start-up company (Figs. 3 and 4). This company produces single-wall carbon nanotubes, CVD-graphene, graphite oxide, and other nano products, does some consulting, and is involved in several national, bi-national, and European research projects. Can the company survive? From the discussion we learned that there are three types of start-ups: One dying very quickly, the other growing fast and becoming rich, and the third type staying small and living long in symbiosis with a university. The company benefits from the symbiosis because they have access to the university infrastructure, and the university benefits from increased flexibility. But the company does not become rich, because there is no entrepreneur taking full risk. The company does not necessarily have to grow, because the "critical mass" of coworkers is shared between company employees and scientists at academia. Should such as symbiotic company file patents? If they want to become independent one day, they should. Patents will make it easier to attract venture capital. ("In fact, the opposite was true: We have got a few very good offers from venture guys who came and were really convinced that this would be the right investment. We did refuse to take this money in order to avoid losing full decision power. We decided building Danubia step-by-step.") But usually such a company will not have much cash, and in the case of doubt they will rather pay for a PhD student than for patent fees. (A patent might well cost 5 000 to 10 000 Euro, and with this money one can pay a PhD student for several months.)

Figure 3 Many small start-ups depend highly on public funding, national and European.

Figure 4 The crew working for Danubia NanoTech in Bratislava.

4 Large research institutes Georg Duesberg (Dublin, Ireland) spoke on "Experience in Project Funding: Industry versus University, Ireland versus Germany". Ivica Kolaric (Stuttgart, Germany) could not be present himself, but he sent viewgraphs on "Project Management: Comparison between Germany and Japan. Georg is working for CRANN (Center of Research for Adoptive Nanomaterials and Nanodevices), which is attached to Trinity College in Dublin, and Ivica is at Fraunhofer Institut für Produktionstechnik und Automatisierung). Both, Fraunhofer Gesellschaft and CRANN, are large research institutions with emphasis on applied research. Patent issues are handled by professional offices. Funding has to be recruited from industry and from funding agencies (Ministry of Research and Technology, European Commission). Georg explained changes in the landscape of research funding in the times of economic change ("from boom to burst"). CRANN had started an initiative to create partnerships with industry internationally, see Fig. 5). When discussing public funding, it turned out that e.g. in Korea the topics are much closer to application than in Europe. In Europe government funding must be "pre-competitive", so that the market is not distorted by favoring an individual company. In comparison to America, funding rates for small companies seem to be much lower, usually around 50%, but the intellectual property rests with the company, whereas in America it is often transferred to the funding authority (Figs. 6–10).

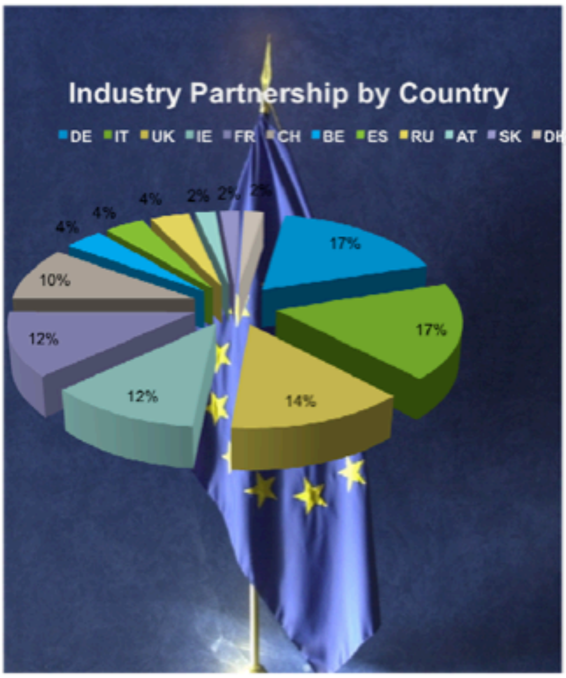

Figure 5 Breakdown of companies working with CRANN Principal Investigators in Europe.

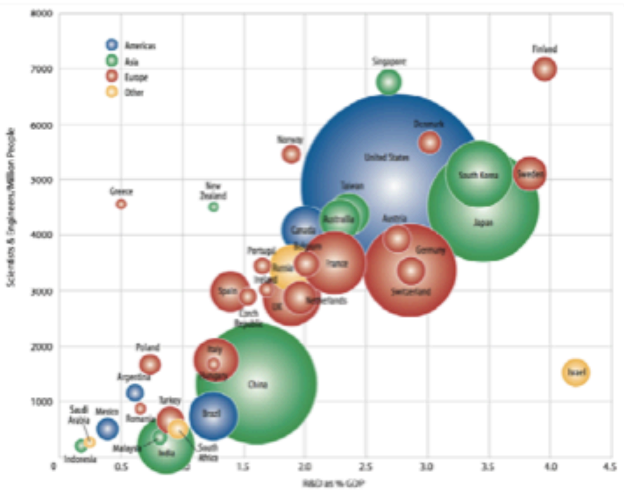

Figure 6 Number of engineers and scientists as a ratio of R&D grant spent from GDP (Source: www.gc-sherie.org).

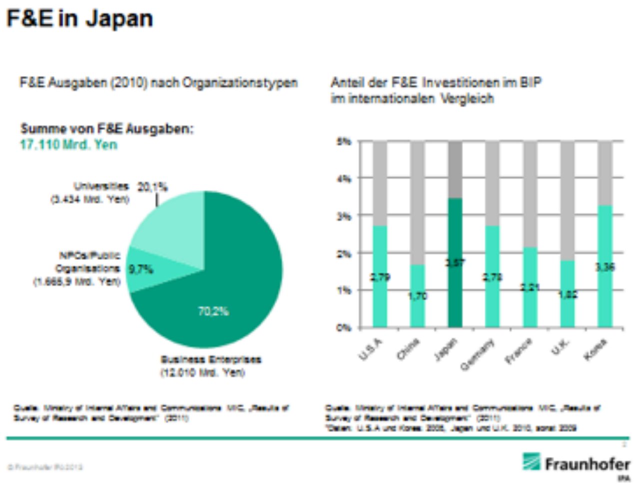

Figure 7 Japan has lost the first position in R&D investment (percentage of GDP) among the industrialized nations. The biggest part of R&D in Japan is spend in companies.

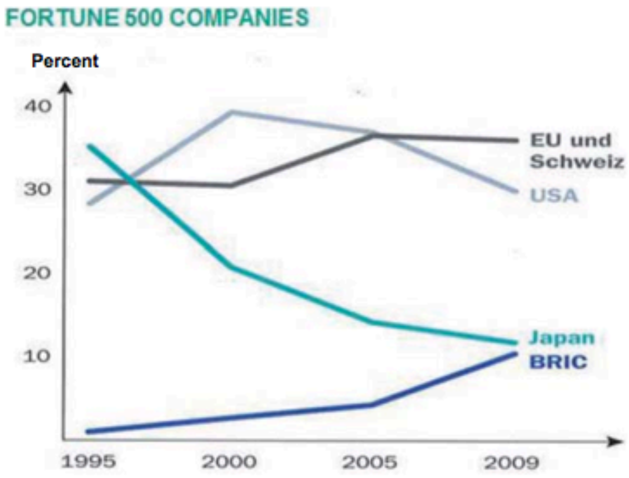

Figure 8 In 1995 Japan has had a 35% share of the biggest companies worldwide. By 2012 this share has reduced to 12%. These losses are mainly due to the rise of the BRIC countries (Brazil, Russia, India, China).

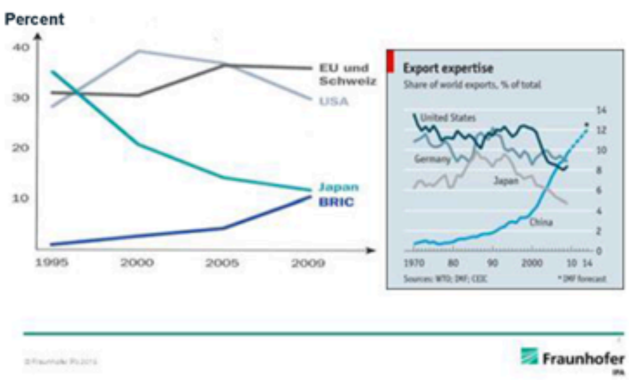

Figure 9 Correlated with these losses is the weakness in exports (decrease in Japan, increase in China).

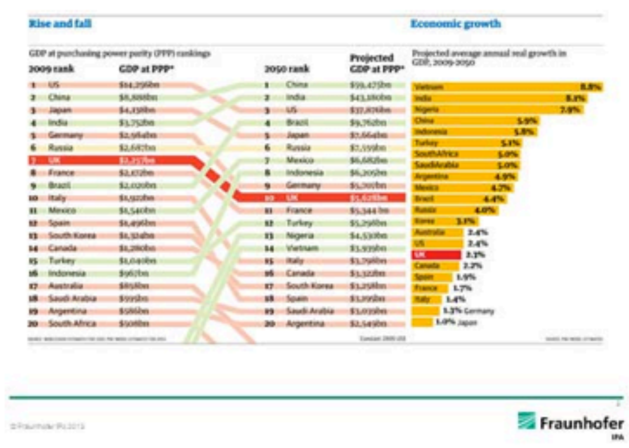

Figure 10 Interestingly, Japan seems to stabilize her position better than Germany or South Korea (probably due to the Japanese strength in high-tech chemicals and batteries).

5 University institutes David Carroll (Winston-Salem, NC, USA) ("Project Management in America: Private and Industry") showed how a fairly large university research team can do both fundamental and applied research, employing specialists for keeping contact to industries and recruiting seed and venture capital. Quite new and interesting for most of us were some numbers: Once scientists say that they found a new effect, investigated it, published it, and filed patents on it, it still takes two more years and two million dollars to develop a demonstrator, another two years and two millions to go from the demonstrator to a prototype, and then much more to go to a pilot plant and finally to a production line. But there are venture capitalists investing in demonstrators, prototypes, and pilot plants – and externally funded development of demonstrators and prototypes can be carried out in university laboratories.

What is important is that the university can make a cost effective partner for companies, but the university research group must approach the program from a different vantage point. Understanding what the company wants, and how they plan to get there will ultimately play the central role in achieving successful funding and transition of technology into the marketplace. Following a modified version of the now famous "Kelly's rules" used by the Lockeed Martin "Skunkworks" we have found a reasonable approach to building a development program.

1) Form a small and focused team for the project
2) Set up a weekly review with the "customer" and allow direct input from the group
3) The team should have its own project subleaders and its own space
4) Set a firm costing for the project and review expenditures regularly
5) Set firm goals based on demonstrations and prototypes, but know the difference between the two. Update funders regularly using a timeline.
6) Work with the customer to achieve non-dilutive funding for other application areas of the technology.
7) Keep as much of the development internal as possible, but add the technical expertise to do so; no short cuts.
8) Set the market vision early and work toward this vision.

The example used in this case was that of PowerFelt. PowerFelt is a fabric-like material that collects heat from its surroundings and converts it into electricity using the thermoelectric effect. Shown in Fig. 11, the felt has the feel and properties of a typical fabric used in garments.

Figure 11 PowerFelt is a new fabric like material that can be used to collect heat from practically any extended body, and convert it into electricity.

But since this material can be used for a wide variety of applications, the research group has worked closely with the commercialization partners to develop opportunities with potential customers. Thus demonstrators for powering wireless devices, for garments, for tarpaulins and other applications have been sought early in the development program. Moreover, significant work has been put into developing performance descriptors and verifying metrics. By leveraging research funding from corporate sources, through joint development agreements, funding for the central development activity can be multiplied and the company undertaking to commercialize the product can benefit from broadening its market base.

6 Conclusion Copies of all viewgraphs presented during the miniworkshop are available at http://www.stuttgartworkshop.org/

References

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