HYDROMEL second meeting with Advisory Board

7th April 2010, Turin (ITALY)

On 7th April 2010, in occasion of the 42 Months Technical Meeting and Consortium General Assembly, Hydromel partners had the chance to have their second meeting with the Members of the Project Advisory Board in Turin. The meeting was hosted at Torino Incontra, one of the Turin Chamber of Commerce in Torino conference facilities.
All the AB members were present: Andrea Reinhardt from MICROTEC (Germany), Luigi Occhipinti from ST Microelectronics (Italy), Davide Giaquinta from SORIN Biomedica (Italy), Alain Codourey from Asyril (Switzerland) and Phil Keenan as independent expert.
Objective of the meeting has been to have an overview of the Hydromel project development, assess the project attained results at the 42 month of work with specific reference to their industrial relevance. Considering the specific Board Members industrial oriented views of in nano-manufacturing process chain, Hydromel partners also got useful hints on how to further investigate business opportunities inside and outside the consortium towards the best exploitation of the technological values brought in by the project scientific and technical activities looking at European as well as worldwide market.
The meeting session started with a concise and clear presentation of the Project Coordinator, Alexander Steinecker, that recalled the overall project objectives and the principle issues of Robotics, processes based on positional- and self-assembly for complex micro-products and hybrid assembly with specific reference to Mechatronics, IT and electronics, and Bio-/Pharma- applications. Steinecker highlighted the Trend towards more complex and more miniaturized micro- and nano products in complex integrated electronics and MEMs devices also detailing the Robotics needs connected with Hybrid Assembly. The introductory presentation also provided some hints on the Hydromel technological platforms, highlighting both the top down and bottom up approaches connecting micro-robotics with self assembly processes towards hybrid assembly. The main technological needs addressed to in the Hydromel platforms have been presented, in particular: the feeding approaches for micro parts, the force controlled grippers systems, the vision algorithms for processing and quality control, the structuring, surface modification and control for self assembly.
The introductory part was terminated by the presentation of the five demonstrators developed within the Hydromel project as concrete application of the technological challenges investigated in the platforms. Experimental cases were introduced by each demonstrator responsible: Jens Tapprogge for the 'Self-alignment assisted MEMS assembly', Quan Zhou for the 'RFID tags assembly', Helmut Knapp for 'Automated Microinjection System for Cells', Alan O'Riordan for 'Palette of Assembly Tools: silicon nanowires-based flexible gas sensor devices, fully integrated and packaged nanowires compatible with electrochemical sensing, carbon nanotubes- based electromechanical switches', and Prof.Quan Zhou on behalf of Petri Melannen for '6-sided automatic visual quality inspection process'.
Finally the Project Coordinator detailed the main features of the action plan towards Project accomplishment.

Following Hydromel presentation the Advisory Board Members had the opportunity to express their opinion on the project activities and the exploitation of their technological value. The discussion was started by the Project Coordinator asking the Advisory Board Members what were their views on the relevance of the technical topics considered in the project with reference to riobotics, self assembly and hybrid methods. A.Couderey commented that in robotics since the first start of the Project there

has been good progress, especially on the side of tools, in particular for microgrippers with force sensing; for self assembly he said 'very nice results have been shown, especially for the manipulation of nanoparticles. assembly is necessary to realize technology and, for example, for nanoelectronics / nanophotoinics demonstrator (Palette of Assembly Tools) it is not possible to separate these two tech objectives'. He added that Hybrid methods, have been shown in the project but further development are needed to exploit full potential. According to Occhipinti views the project was 'effective to combine top down with bottom up approach to extend the scope of robotics and self-assembly'. Moreover he stressed the point that the self assembly dealt with in the project is relevant for application in 3D integration of die-on-die and die-on-wafer assembly methods. Reinhardt expressed her appreciation for the quite interesting approach for different fluids used in self assembly. Nevertheless she commented: 'self alignment and self orientation, processing steps to support self alignment are missing the perception of efficiency of the process. Industry needs small number of steps for future exploitations. It is not advisable to add too many steps. Energy efficiency is another issue to be more highlighted'. Regarding the hybrid methods she commented: 'since the starting of the project there has been an interesting progress, but I assume that applications foreseen are not mainly in Life sciences'. P.Keenan concluded the first tour of comments acknowledging the high relevance of the work done for robotics and for the self assembly results he commented: 'Probably this is most likely the path to commercialization'.

Proceeding from general to particular topics Steinecker asked the Advisory Board about the relevance of the demonstrator activities. First to comment on the 'Self-alignment assisted MEMS assembly'demonstrator was A.Codourey: 'This demonstrator deals with the parallelization of the assembly of MEMS by combining Robotics and Self-Assembly. The assembly is very tricky because the parts are very fragile. Good results are achieved so far. Question: in what is the technology used different from the one of a die-bonding machine available on the market?'. The involved partners clarified the innovative character of the process as a whole and L.Occhipinti added: 'The success of this demonstrator has a direct relevant impact to improve the manufacturing of products based on modules with e.g. MEMS components on PCB. The industrial end-user in the consortium (FemtoTools) is well positioned to take benefit of the capability developed in this field and to exploit the result in automatic assembly of MEMS grippers'; he added: 'MEMs assembly is a good example for industrialisation stage, and direct interest for Femtotools is evident in the project and for further exploitation since this is a real industrialisable packaging process. On top of that the innovation generated in Hydromel could be exploited outside the consortium'. P.Keenan commented: 'I liked this work, and the example given in the assisted assembly of a scanning probe tip. However, this work is not breakthrough, nor leading edge. And some of the techniques described are not dissimilar to those used at IBM in the early 80's'. D.Giaquinta added 'This demonstrator is well developed but needs more investment to reach the industrial stage development'.

Following the interview tour A.Couderey expressed his views on the second demonstrator. 'This demonstrator deals with the RFID Assembly. This is a topic of very high importance, especially because the cost of RFID-Assembly needs to be reduced. Different methods are used in industry today. The classical approach is based on modified die-bonding machines. Another method is based on self-assembly. Hybrid methods are new, but the results shown in the project up to now are not at the stage of existing methods on the market'. L.Occhipinti went further: 'the demonstrator is very well developed and promising. So far many technological trials have been done in the demonstrator development, but now it's time to make a choice which technology to use. The work started here should be continued to develop the full optimized process flow-chart and related tools and equipments to be made available for commercial exploitation in the micro and nanoelectronics industry, as it is expected to grow significantly in this sector', L.Occhipinti also recalled 'As noticed also in the previous Advisory Board meeting, in the case of RFID application, the cost effectiveness is a driving factor for industrial exploitation. It is suggested to involve more deeply equipment suppliers (including those already in the consortium, e.g. Datacon) in the cost analysis and benchmarking in order to better develop the business case'. A.Reinhardt observed that 'if cost aspect is compatible the results are interesting for many applications, for e.g. intelligent food quality controlling by RFIDs'. D.Giaquinta concluded by saying: 'This demonstrator, if compared with the Cell injection system needs more focus on the selected technology and subsequent more investment to reach the industrial stage development'.

Connected to the third demonstrator, A.Codourey stated that 'the cell injection system is a very nice demonstrator. The benefit of this technology is obvious and might have a great market potential. Being favorable to the third demonstrator, L.Occhipinti commented: 'the cell injection system is a well focused demonstrator, ready for commercial exploitation in this specific application for cell injection and sorting in the bio pharmaceutical industry. The demonstrator is perfectly in line with the worlk programme. There are already existing potential customers to provide exploitation'. P.Keenan added: 'This is an excellent project, and well delivered was the most mature of the projects seen in Hydromel; this is a system close to commercialization. It had an excellent level of integration of vision, robotics, sensing, and a clear path to market identified. The marketing and sales of such a system should be straightforward'. Also D.Giaquinta added:' this demonstrator is the closer to product and commercialization, whereas the other demonstrators need more investment to get an industrial result'.
For what pertaining the fourth demonstrator dealing with nanoelectronics and nanophotonics A.Codourey said: 'it is very promising and new results have been shown since the last Advisory Board meeting. However, this technology is still at the beginning and a lot needs to be invested to be able to use it in industry, nevertheless the market potential is enormous'. According to L.Occhipinti: 'The focusing effort made in this palette of demonstrators since the last review meeting has been recognized and appreciated. The results reported here are interesting and the related research should be continued. The applications are very much impressive, at this stage of the project development, the applications and targets are defined, especially for the case of nanaosensors. As declared by the demonstrator leader, the IT space is very crowded and new applications such as that of gas sensors e.g. for NO2 sensing and for toxic gases sensing will be much interesting to apply'. On this purpose P.Keenan added: 'Nanowires is a topic of great interest mainly to researchers; but in my discussions with the industrial people they have not demonstrated a particularly strong interest in nanowires commercialization. One of the barriers to commercialization is the development of a viable assembly method for mass production. I found this piece of work lacking in this regard'. Although recognizing the high potential of the topic treated in this demonstrator, D.Giaquinta commented: 'This demonstrator, if compared with the Cell injection system needs more focus on the application and it will require further investment to reach the industrial stage development', and he stated: 'time to market is definitely not short'.
For the last demonstrator focused on laser diode inspection system for IT applications, that has been presented to the Advisory Board, A.Codourey communicated his considerations saying: 'A machine for inspection of laser diodes has been developed. In this demonstrator it is not really clear what the benefit is compared to other systems available on the market. An effort still remains to be done to transfer the "laboratory" technology into a production equipment. But this is not the scope of a research project'. On the other hand L.Occhipinti recognized that 'the concept of capillary gripper developed in this application is relevant as a tool for other manufacturing techniques, including for instance advanced 3D integration technologies for multichip modules at both wafer and silicon die level (e.g. Die on Die, Die on Wafer)'. Strengthening this position P.Keenan added: 'Simply elegant. Use of water droplet and temperature is elegant and an excellent application of the Hydromel principles'.
Following this round tour of opinions on demonstrators at different stage of accomplishment, A.Steinecker asked the Advisory Board Members on the possible industrial interest of developed solutions for other applications.
A.Codourey pointed out that the manipulation of nanoparticles opens new perspectives for the fabrication of very tiny sensors; whereas L.Occhipinti further stressed the relevance of use of self assembly methods in Die on Die and Die on wafer assembly for 3D integration. With specific reference to the topics treated in third demonstrator, P.Keenan commented: 'the cell sorting concept could be applied to smaller and smaller objects, small cells, virus, etc. This is of potentially great interest in the development of Gene factories, the expression of materials from cells on demand. On this purpose, I enjoyed presentation and conversation to next steps commercialization, but this is a quite challenging stage. I suggest to make proactive marketing , I would be happy to provide some support on that'. A.Reinhardt pointed back to self assembly methods saying: 'in a position of investor, if I have plenty millions, I would invest in self assembly orientation, I would not invest in life sciences applications, but rather in electronics and games, in which a lot of research is needed to be done. Further to this- she continued- I would try to focus on nanowire based applications. The strategy

to concretize this business would be to use the products to explain the potential of developed technologies. Nanowires are not already commercialized but represent a very interesting solution for new products'.
Moving to further specific topics A.Steinecker asked the Advisory Board Members to express their possible interest on those topics investigated in Hydromel project and on presented results that pertain- or that are possibly connected to- the different Advisory Board Members' field of activity.
While A.Codourey stressed once more the interest in the manipulation of tiny components and objects referring to nanoparticles, L.Occhipinti indicated to the use of precise positioning and self-assembly techniques on plastic substrates such as electronics on flexible foils; nevertheless, he also considered gas and ambient parameters sensors for ambient intelligence and healthcare applications a viable exploitation route of the presented solutions. P.Keenan re-marked his interest in the third demonstrator results and said: 'I work across the board of Nanosciences, sensors etc. The cell sorter system is my favorite result, and when I see an opportunity I will help the inventors exploit its value'.
Then the project Coordinator asked the Members: 'accroding to you what are the principle aspects that should go further ?'
A.Codourey replied stressing once more that the manipulation of nano-particles should be considered. L.Occhipinti put the focus on dedicated equipments for capillary force self-assembly as standard assembly techniques including 3D integration of small dices and systems on foils manufacturing. A.Reinhartd, considering time frame perspective said: 'among the topics that have been presented today the cell handling seems is the most easy to exploit in the middle term, while in the long term I see the contribution to nano photonics and other light emitting products as very interesting opportunity'. P.Keenan followed: 'The micromanipulation and handling of complex materials has industrial opportunities but in my opinion there are no mass-market opportunities. Furthermore I would have liked to have seen two or more of the technologies demonstrated in Hydromel to have been combined into a production prototype assembly system, and had a product associated with it to demonstrate opportunities' - he continued – 'I would suggest to also consider an hybrid approach providing synergies to integrate two or three approaches to enhance value. Device and manufacturing cannot be taken separately: they have to be combined'. P.Keenan, re-marking his believes in the value of the achieved technological results of Hydromel further commented: 'Considering the lacking aspect of solutions marketing (which is typical in FP6 structure) I would be happy helping hydromel people to support market search to reinforce exploitation potential and development'. L.Occhipinti pointing to perspective considerations concluded: 'Some demonstrators are in less advanced stage: for these I would invest not in direct industrialization but in further development, if I were a venture capitalist I would put effort in IT – RFID tag assembly and in nanoelectronics / nanophotonics as the best business promising solutions'.
In order to get useful advise towards the best possible project accomplishment A.Steinecker asked the Advisory Board Members to communicate their feeling about project status compared to the previous meeting.
According to A.Codouderey point of view from previous meeting, things have been consolidated incrementally and no new breakthrough are assessed from previous meeting. L.Occhipinti answered 'in my opinion the consortium has taken benefit from previous advises and has successfully developed the state of the art demonstrators'. A.Reinhardt commented: 'I can see good progress including much more clear orientation to direct exploitation, but activities have still to be improved in the area of bench-marking with other industrial approaches considering costs, speed of assembling, precision, etc.'. Strengthening the exploitation issue P.Keenan replied: 'My overriding feeling was that the teams really needed a marketing function to help them take their ideas to their natural conclusion, i.e. exploitation. This is not a negative reflection on anybody or anything in Hydromel, but really a reflection of how we structured FP6 in the EU. Hopefully, we are getting better at this'. D.Giaquinta concluded: 'From an industrial point of view I am impressed of progress with respect to what shown at the last Advisory Board Meeting in Paris. For the three demonstrators focussed on RFID tags, nanoelectronics-nanophotonics and visual inspection there is the need to put more effort in the next months to be more focused on industrialization. Nevertheless Hydromel Consortium should be wondering which performance, profitability, productivity, manufacturing time, production cost, maintenance activity, … are involved with specific applications'.

After more than three hours of presentations, discussions, further investigation on technological, industrial and exploitation issues the Advisory Board got a clearer view of the project status of development and provided useful opinions, and advised the Coordinator and Hydromel Consortium on how to best capitalize 42 months of intense effort in different technology domains, targeting to innovation and competitiveness, towards the successful accomplishment of the Hydromel challenge in the last six months of planned work.