

POLYMICRO - A Virtual European Center for the Industry

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Abstract

POLYMICRO Competence Centre supports industry by opening up the high value market of custom specific micro-optics in polymers. These services have been offered to the European industry in form of a EUROPRACTICE Competence Center for the last 3 years. Interesting new optical components have been developed and introduced onto the market in this time. Significant benefit in reduction of development cost and time-to-market could also be achieved.

Now this supported network will be transformed into a service for industry. Experience gained in the last years call for a broadening of the activities, expanding from the present offered micro-optical components by the Competence Center core members towards complex micro-optical systems, with additional partners. The new POLYMICRO-CC will then be a pool of competent partners to design, to prototype, as well as to manufacture complex micro-optical systems.

1. Introduction and Application Areas

Micro-optics is an enabling and emerging technology field with one of the highest growth rates in the area of MEMS. In this area polymer production technologies are playing a growing and important role, because of the inherent advantages of polymers for optics and for micro-optics:

- New optical systems are possible, e.g. by LED and laser applications, by camera chips, in displays, together with polymeric optics,
- Easy system integration is possible, e.g. for sensors, or for camera modules
- New improved optical functions are under investigation

The fabrication technologies include lithography processing like UV-lithography, E-beam lithography and X-ray lithography, micromoulding like injection moulding hot embossing or UV embossing, microparts assembly like glueing and bonding and even more which allow for low cost mass fabrication of micro-optical components and systems.

Micro-optics is an emerging field and will play a key role in many future products:

- **Imaging/displays** with micro lens arrays for improving detection efficiency and miniaturised imaging applications, micro-optics for 3D-displays, fibre illumination devices, electronic paper, micro-optical solutions in back and front lighting of small displays, e.g. in mobile phones and PDAs, etc.
- **Medical and biomedical applications, with components like** micro-spectrometers, micro analysis systems, lab-on-chip analytical systems, etc.
- **Information technology and communication**, with components and systems for fiber optical communication, like micro lens arrays for optical switching, laser diode/VCSEL collimation and connecting to optical fibres, fibre connectors, both for multimode devices as well as for single mode devices, waveguides and wavelength colour filters for DWDM

applications. Also optical devices for mobile phones can be seen here, e.g. virtual keyboard or infrared interface.

- **Industrial automation**, safety and identification, with optical components and systems like distance sensors, linear and rotational encoders, personal recognition systems, finger print sensors, rain sensors, colour filters, etc.
- **Automotive systems**, with modern lightning systems, mainly based on LEDs, displays, optical sensors, up to driver assistance systems (ACC), polymer optical databus, head-up displays, etc.
- **Consumer goods and household appliances**, e.g. with CD/DVD pick-up head, displays, etc

A strong increase in the future is predicted in all areas, but in particular in the life science and in the health care market with biophotonic products.

2. The Polymicro Competence Center

The POLYMICRO Competence Center (<http://www.polymicro-cc.com/>) is a co-operation of 5 partners from all over Europe, who formed a virtual center, supported in the last three years within the EURO PRACTICE initiative under the frame of the IST program of the EC scheme /1/. They are working together on a mix of complementary and common activities to generate awareness in the industry for this new technologies and their possibilities, making available general information on polymer micro-optics (in particular with a comprehensive web site) and acquire customers for research, development, optical design and prototyping, up to serial manufacturing of micro-optical devices. Finally the possibilities to continue these activities in a self running venture have been investigated.

Partners of the POLYMICRO competence centre are:

Forschungszentrum Karlsruhe GmbH, in particular with **the Institute for Microstructure Technology**, offering polymer-micro-optical system based research and development, prototyping with lithographic methods, high aspect ratio replication techniques (injection moulding, hot embossing, and fabrication of high aspect ratio replication tools by the LIGA process).

Heptagon Oy in Finland and Switzerland focuses on the development, design and manufacturing of diffractive and refractive replicated micro-optical components. Their production processes comprise direct laser beam writing, electron beam lithography, relief printing, and hot embossing. Their UV-embossed components withstand temperatures ranging from -40°C to +125°C. Also available is sol-gel processing for components with stability in humid atmospheres and high temperatures.

Epigem Ltd., in Redcar, UK, provides new product development support in polymer MST, from concept to high volume manufacturing. Moulding processes include high accuracy replication on rigid sheet or wafer substrates or flexible film using continuous reel-to-reel multilayer coating, micromoulding and lamination. Epigem also gives assistance in integrating micro-optics with other functions including micro-fluidic and micro-metallic structures.

Daren Laboratories and Scientific Consultants Ltd. from Nes Ziona in Israel has good expertise in the development of polymers to match the optical properties to desired values. This involves the synthesis of new materials, tailor made to meet specific applications, as well as process optimisation to reduce, e.g., sensitivity to temperature and humidity. During the project Daren Lab. founded a new company HPOP in Israel, which started with business angel support, followed by governmental support /2/. HPOP's business approach is to develop and produce specific optical polymers with low thermal expansion coefficients.

Sgt Sensor Consulting Dr. Guido Tschulena from Wehrheim, Germany makes technical and economical investigations, helping industry to find the best suited OEM-components, to decide on investments into research and development as well as on technical solutions and on fabrication possibilities

3. Polymer Optical Industry in Europe

During the last 3 years of common activities about 130 European companies in the POLYMICRO area have been contacted and analyzed. Their size distribution is shown in figure 1.

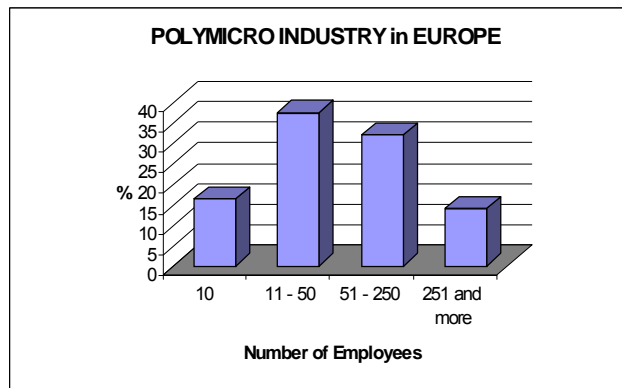


Figure 1: Size distribution of European companies in the Polymicro area.

The companies range from small start up companies up to large enterprises. Nevertheless, more than 85% of the companies have less than 250 employees. These companies are on one side very competent in specific process techniques or on the other side very innovative in developing micro-optical systems for new applications.

Although there are a lot of successful developments of micro optical systems in European industry and R&D laboratories, it has been very difficult to establish industrial manufacturing on a broad scale. Fragmentation into a lot of individual process techniques result in non-existent qualified production lines. Thus, there is the need to integrate the wide spectrum of disciplines and technologies necessary to manufacture micro-optical systems and to allow industrial production.

By forming co-operations and networks between the technology oriented SMEs the whole fabrication chain to realize micro optical systems will be covered and complete optical instruments for the markets can be offered to customers.

3. POLYMICROs future business strategy

Based on our experiences we identified a need to set-up an organisation which integrates the segmented technologies to fabricate micro-optical systems (see fig. 2) /3/. This will be done by establishing a pool of partners which are able to manufacture the micro-optical system in the distributed environment. These partners will have a comprehensive technological portfolio, including polymer techniques, silicon micro-optics, thin film techniques, electronics, assembly and handling capabilities as well as opto electronic, micro fluidic and micro mechanical technologies. All these technological capabilities are typical for SMEs, and will be brought together and formed to individual customer projects by the POLYMICRO Office. In addition the POLYMICRO office has the responsibility for the engineering work necessary before manufacturing can start. To be able to do this the POLYMICRO office will fall back upon R&D organisations, which are also members of the POLYMICRO organisation. It also has close contacts to the European research networks to

be informed about the newest developments in micro optics and to address very specific basic questions when doing the engineering work. In addition common marketing activities and activities to generate awareness for micro optics and for the business of POLYMICRO will be performed.

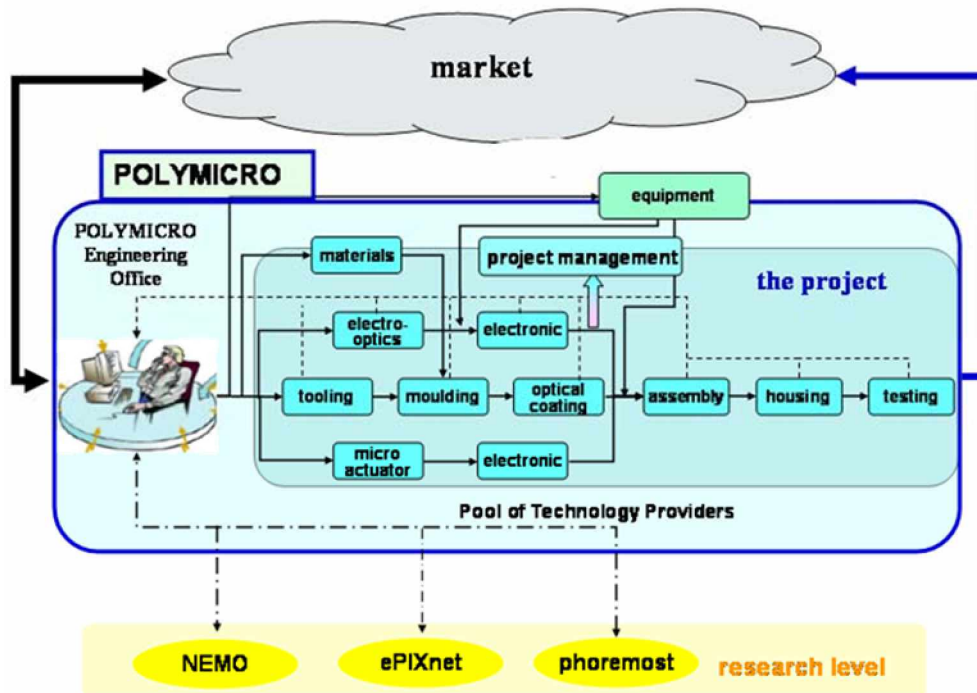


Figure 2: New Polymicro Competence Center business model.

4. Conclusion

Based on its three years experience in generating awareness in European Industry for polymer micro optics, POLYMICRO aims to set-up a new business strategy. This business strategy allows on one side SMEs, active in system development, to get easy access to chain to manufacture micro-optical systems. On the other side technology oriented SMEs can participate in the manufacturing chain and gain additional business. To set-up the business approach a clear market analysis has to be performed, additional small companies with complementary skills, both from a technical and from a geographical point of view, have to be interested to join the pool of high tech companies in the area of optical systems. On the other hand customers and projects both from industry and also from governmental organisations have to be identified. If you have interests in participating in the best teams which are able to offer a high quality technical solution within appropriate timing or if you are interesting in using POLYMICROs service you should get in contact with us.

References

- /1/ H. Hoffmann, "POLYMICRO – Polymer Micro-Optical Components, Systems and Fabrication Techniques", Sensor Magazin 4 (2002) p. 18
- /2/ Steve Daren, "A New Start-up from Europractice – HPOP, mst news 04/2004 (2004) p 27
- /3/ H. Hoffmann, J. Mohr, „Verteilte Fertigung von optischen Mikrosystemen“, Mikroproduktion 2 (2005) p. 37

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