

**Fifth Project Meeting  
&  
Sixth Training Day „Nanofabrication“  
in Hannover (Laser Zentrum Hannover), Germany  
April 4-6, 2016**

**PRACTICE IS ESSENTIAL**

The possibility of very high temporal and spatial localization of laser energy has led to new advanced laser applications. Particularly, the interaction of lasers with polymers and dielectrics is of high technological interest. One of the rapidly advancing femtosecond laser technologies is three-dimensional micro-/nano-structuring by multiphoton illumination technique. Taking its origin from multiphoton microscopy, it is now becoming an important microfabrication technique. This micro-/nano-fabrication is known as **two-photon polymerization (2PP)**. Using femtosecond lasers, complicated microstructures can be produced in photosensitive materials. 2PP is very attractive 3D rapid micro-/nano-structuring technology, which provides much better structural resolution and quality than the well-known stereo-lithography (SL) technique. Development of this innovative technology represents interdisciplinary efforts of physicists, engineers, and



**Figure 1.** During one of lectures.

chemists. The adaptation of polymer properties to laser characteristics and vice versa is very challenging from the scientific and technological points of view. Physicists are involved in the investigation of multiphoton processes and characterization of the produced structures, chemists are working on the development of novel materials, and

engineers are designing hardware and workstations for different applications of this technology.

**5<sup>th</sup> Meeting and 6<sup>th</sup> Training day of Nano2Fun Project** took place in Hannover, Germany. At the site of Laser Zentrum Hannover (LZH) researchers across Europe gathered to present current state of research work and to discuss further scientific and collaboration plans.

The event started with an extensive but no less interesting and inspiring lecture “Laser based nanotechnologies” by Prof Boris Chichkov (LZH) His report covered most of modern laser nano-fabrication technologies with especially exciting part about the massive research in Nanofabrication carried out at LZH.

Following poster session was focused on on-going collaborations within Nano2Fun Project. Young scientists presented their joint research activities.

The second day started with current progress presentations of fellows, which were grouped into three sections: Enabling knowledge, Two-photon polymerization and Two-photon microscopy. Participants have demonstrated very high level of presenting skills. Apparently, past Nano2Fun training days made certain contribution to this improvement.

Dr. Benedikt Stender from “Multiphoton Optics” company told about the look at the 2PP technology from the industry side and presented main applications of nano- and microstructures “Multiphoton Optics” produce with this technology.



**Figure 2. During laboratory exercise for Nano2Fun fellows.**

Good old UV-lithography technique takes significant place in nanofabrication world. Prof. Dr. Carsten Reinhardt (LZH) made incredibly vivid introduction into this useful technology. He described modern research directions in this field,

including ones carried out at LZH. 3D-printing using nanoparticles certainly will be remembered for the audience.



**Figure 3. Scanning electron microscope image of the structure fabricated during practical training on 2PP.**

The meeting was orientated to the practical training of the Nano2Fun fellows. Laboratory exercise on 2PP fabrication technique consisted of the following:

1. Preparation of the sample for 2PP fabrication.
2. Structure fabrication on 2PP setup.
3. Development of the polymerized structure.
4. Observation of fabricated structure with scanning electron microscope (QUANTA 400 FEG).

E-Shell-300 (EnvisionTEC GmbH, Germany) was used as the material. The whole process of the sample preparation, structuring and post processing took about 2 hours.

Also the lab tour was organized for all participants, so that they could form integrated impression of current work and capabilities of Nanotechnology department of LZH.