

History of the Institute of Semiconductor and Solid State Physics

The solid state physics group with the former head Professor Helmut Heinrich was founded in 1972 at the Johannes Kepler University of Linz. Due to long and prosperous collaborations between the groups of Günther Bauer and Helmut Heinrich, joint efforts enabled the acquisition of resources for the creation of a new building – the “*Bauernhäusl*” – on the JKU campus.



Ground-breaking ceremony by the minister of science and research Erhard Busek, the mayor of Linz Franz Dobusch, rector Ernest Kulhavy, and governor of Upper Austria Josef Ratzenböck (1990).

Coming from Leoben, Günther Bauer got his full professorship in Linz in 1990. The new Institute of Semiconductor Physics was situated temporarily in a dormitory and also within the rooms of the Solid State Physics group which belonged to the Institute of Experimental Physics at that time. After the completion of the Semiconductor Physics building in 1991, the Semiconductor Physics Institute, headed by Günther Bauer, moved into the lower two floors of the new building.

The Solid State Physics group of Helmut Heinrich moved from the 10th floor of the TNF tower into the upper two floors of the new institute building.

In the first half of 1992 the cleanroom in the basement of the building was finished, the starting shot for the investigation of new fields of material and device preparation.

Though sharing the same building, the two groups did not form a single institute yet. The Solid State Physics group was still a division of the Institute of Experimental Physics, and a

change of the organizational structure turned out to be far more complex than the construction of the new building. It was finally accomplished in 1996 in connection with the implementation of the then new University Organization Law UOG'93. In order to represent both groups adequately, the name of the joint institute was changed to “Semiconductor and Solid State Physics” and the position of the head of the institute circulated between the four full professors of the institute, Günther Bauer, Helmut Heinrich, Wolfgang Jantsch and Friedrich Schäffler.

Apart from the organizational changes within the history of the Institute of Semiconductor and Solid State Physics, substantial growth and changes in the scientific and personnel structure can be observed.

Several Institute members received their habilitation in Linz: Manfred Helm (1993), Wolfgang Faschinger (1995), Günther Hendorfer (1998), Gerhard Brunthaler (1998), Gunther Springholz (1999), Kurt Hingerl (2002), Wolfgang Heiss (2002), Julian Stangl (2007), and Alberta Bonanni (2008).

Several former Institute members were appointed full professors at various universities: Klaus Lischka in Paderborn 1993, Wolfgang Faschinger in Würzburg in 1995 (who died suddenly in 2001), Manfred Helm in Leipzig 1999, Heinz Krenn in Graz 2000, Anton Darhuber in Eindhoven (2007), Zhenyang Zhong in Shanghai (2008). Kurt Hingerl was appointed temporarily in 2010 as head of the newly founded Institute of Surface- and Nanoanalytics (ZONA) at the Physics department of JKU in Linz.



The wide field of scientific work covered by the Institute became only possible by raising funds for a large number of research projects. Among them are priority programs such as “Spezialforschungsbereich” SFB025-IRON „Infrared Optical Nanostructures“ of the Austrian Science Fund FWF. It is organized by K. Unterrainer (TU Vienna) and G. Bauer with five out of eleven sub-projects being coordinated at our Institute in Linz.

- Project Cluster Nanostructured Surfaces and Interfaces (NSI) of the Austrian NanoInitiative, organized by F. Schäffler with eight research projects and 14 partners

from academia and industry.

- National Research Network (NFN) on “Interface-Controlled and Functionalized Organic Films”, bringing together the Austrian organic semiconductor community, organized by H. Sitter..

In addition there was a large amount of further research projects from the European Community, the Austrian Science Fund (FWF), the “Österreichische Forschungsförderungsgesellschaft (FFG), the Province of Upper Austria, and other sources.

Important support for the cleanroom infrastructure came through all these years from the Society for Micro- and Nanoelectronics (GMe), Vienna, and from the Ministry for Science and Research (BMWF) through its infrastructure programs for universities. In addition, a Christian Doppler Labor for Surface Optics (organized by K. Hingerl) was run at the Institute from 2003 to 2010.

Industrial collaborations on educational, scientific and technical level were realized with several companies, among them Infineon, Siemens, AMS Unterpremstätten, IMS, EVG, Profactor, E+E Elektronik, Konarka, Philips Analytical and many others.

As an outcome of applied research also several patents were filed and granted.

The Institute of Solid State and Semiconductor Physics got recognition for substantial contributions to

- Semiconductor nanostructures
- epitaxial growth of group IV, group-III nitrides, II-VI and IV-VI heterostructures
- self-organized and seeded growth of these materials
- growth of semimagnetic semiconductors
- Nanostructure characterization by
- x-ray scattering and diffraction
- photo-luminescence
- transport and magnetotransport
- transmission electron microscopy
- optical and transport devices based on these materials
- Metal-to-insulator transition in Si MOS-FETs and Si/SiGe heterostructures
- Defects in semiconductors, in particular
- DX centers in III-V compounds
- Optical doping of Si by rare earth elements
- Implantation defects
- Dislocations
- Polymorphism in nanowires
- Infrared detectors
- Synthesized nanocrystals and their use for devices
- Spin properties of confined electrons, particularly in Si/SiGe heterostructures
- Organic semiconductors
- Magnetic semiconductors and alloys

In the past 20 years, the Institute members organized a number of international conferences, symposia and workshops:

- The biannual International Winterschool in Mauterndorf, which started in 1980, and thus

celebrated its 30st anniversary in 2010. The Winterschool was originally organized by G. Bauer, H. Heinrich and F. Kuchar, with W. Jantsch moving in for H. Heinrich in 2002.

- Internat. Symposium on DX Centres and other Metastable Defects in Semiconductors (W. Jantsch, G. Brunthaler and R.A. Stradling, Mauterndorf 1991)
- 17th Int. Conf. on Defects in Semiconductors (W. Jantsch – Gmunden, 1993)
- 4th International symposium on Atomic Layer Epitaxy and Related Surface Processes – ALE-4 (H. Sitter – Linz, 1996)
- 5th Int. Conf. on Intersubband Transitions in Quantum Wells (Manfred Helm, Karl Unterrainer – Bad Ischl, Austria 1999)
- 10th Int. Conf. on Modulated Semiconductor Structures (MSS10) (G. Bauer, Linz, 2001)
- E-MRS Spring Meeting Symposium Q: “Current Trends in Nanotechnologies: From Materials to Systems”, Strasbourg (W. Jantsch, G. Marletta and H. G. Grimmeiss, 2002)
- 12th Euro-MBE Workshop (F.Schäffler, G.Springholz, H.Sitter, Bad Hofgastein 2003)
- 28th Int. Conf. on the Physics of Semiconductor – ICPS (E. Gornik, G. Bauer, Vienna 2006)
- 8th Int. Conf. on Mid-Infrared Optoelectronics: Material and Devices – MIOMD (Gunther Springholz, Bad Ischl 2007)
- Spring Meeting of the European Materials Society (W. Jantsch, F. Priolo and H. Richter – Strasbourg 2008)
- Spring Meeting of the European Materials Research Society, on: “Interface controlled organic thin films” (H. Sitter, K. Al-Shamery. H.G. Rubahn, G.Horowitz, Strasbourg 2008)
- 9th Biennial Conf. on High Resolution X-Ray Diffraction and Imaging – X-TOP (Julian Stangl, Günther Bauer – Linz 2008)
- 5th Int. School and Conf. on Spintronics and Quantum Information Technology [Spintech V] (T. Dietl, M. Sawicki, E. Zipper, A. Bonanni – Krakow, Poland 2009)
- Eur. School on Magnetism 2009 [ESM 2009], Focus Workshop “Inhomogeneities in magnetic systems” (A. Bonanni; Timisoara – Romania)
- APS March Meeting 2010] Focus Sessions "Spin-Dependent Phenomena in Semiconductors” (A. Bonanni, M. Tanaka and P. Crowell – Portland, Oregon 2010)
- E-MRS Fall Meeting, Symposium N: “Inhomogeneous and hybrid magnetic semiconductor systems” (A. Bonanni, T. Story and J. Majewski – Warsaw, Poland, 2010)
- 39. Int. “Jaszowiec” School and Conf. on Phys. of Semicond., Symp. (Nano)characterization methods for Semiconductors (A. Bonanni, J. Majewski – Krynica, Poland, 2010)

In addition, Institute members contributed in various program committees and organisational boards of other conferences and meetings.

During the last 20 years many researchers came to the institute as guest professors or visitors, among them the following:

- Bob Algaier (NRL, Washington)

- Jurek Langer (Inst. Physics, Polish Academy of Sciences, Warsaw)
- Włodimir Zawadzki (Inst. Physics, Polish Academy of Sciences, Warsaw)
- Bennett Goldberg (Boston University)
- Jan Blinowski (Warsaw University)
- Jan Gaj (Warsaw University)
- Zbysław Wilamowski (Inst. Physics, Polish Academy of Sciences, Warsaw)
- Vladimir Pudalov (Lebedev Institute, Moscow)
- Tomasz Dietl (Inst. Physics, Polish Academy of Sciences, Warsaw)
- Sigurd Wagner (Princeton University)
- Hermann Grimmeiss (Univ. Lund)
- Steve Lyon (Princeton University)
- Václav Holý (Univ. Brno, now Univ. Praha)
- Rafał Dunin-Borkowski (Center of Nanoscopy, Technical University of Denmark . Copenhagen)



With over 100 students and staff members, the Institute of Semiconductor and Solid State Physics has now reached a state close to the capacity of the Semiconductor Physics building that was, 20 years ago, certainly not planned with such a development in mind. Three of the four original full professors are now already retired (Helmut Heinrich, succeeded by Reinhold

Koch in 2006, Günther Bauer, succeeded by Armando Rastelli in 2012, and Wolfgang Jantsch, succeeded by Andreas Ney in 2012).

Evidently, these are challenging times, but they also offer new chances for the further development of the Institute. Based on the development during the last 20 years, we can look forward with confidence to the next 20 years of Semiconductor and Solid State Physics in Linz.