

# NOBEL FOR CHEMISTRY 2007 >>> PRIZE

After 19 years, again a German scientist wins the Nobel Prize for chemistry: Gerhard Ertl for his analyses of processes on solid surfaces.

The 2007 Nobel Prize for chemistry honors a personality who has influenced the surface sciences like no-one else. Gerhard Ertl, emeritus scientific member and director at the Fritz-Haber-Institute (FHI) of the Max-Planck-Gesellschaft in Berlin, is also the “scientific great-grandchild” of the institute’s founder and eponym. He was informed about this great prize, which he receives undivided, just on his 71<sup>st</sup> anniversary, October 10<sup>th</sup>, 2007. Spontaneously, the whole institute, his friends and collaborators, together with a full squadron of journalists celebrated this event with him.

The last Nobel Prize for the FHI, was won by Ernst Ruska in 1986 for his invention of electron microscopy. In its almost 100-year-old history, four more Nobel Prize winners had been working at the institute: Fritz Haber, James Franck, Otto Hahn, and Max von Laue.

## Fritz Haber's scientific great-grandchild

Heinz Gerischer, the doctoral advisor of Gerhard Ertl and previous director of the FHI, was the student of Karl Friedrich Bonhoeffer who was the director of our institute after the Second World War and on his part a colleague of Fritz Haber. Here, a scientific circle closes. Between 1905 and 1908 Haber discovered the process of the synthesis of ammonia from the nitrogen of the air, which then Carl Bosch brought to technical maturity at BASF. For this discovery, Haber had won the Nobel Prize in 1918, with the advice that the possibility

to produce fertilizer saves Europe from suffering an upcoming famine.

The following fifty years and more were characterized by understanding the mechanism through which the most powerful known bonding between two atoms, in the  $N_2$ -molecule, breaks down on the surface of an iron-based catalyst. In 1975 Paul Emmett, an eminent physical chemist, said: “*The experimental work of the last 50 years has taught us that the speed-determining step in ammonia synthesis is the chemisorption of molecular nitrogen. However, the question whether the species on the surface (which then is being hydrogenated) is atomic or molecular has not yet been answered convincingly.*”

Shortly thereafter, Gerhard Ertl and his group showed - by using methods already developed in the new field of surface chemistry - that the step by step hydrogenated species is atomic nitrogen. These achievements clearly revealed Gerhard Ertl’s great talent to analyze the essence of a complex process through a simple experiment. The secret of the mechanism had been disclosed about 70 years after its invention by Haber.

## Atomic structure and dynamics of solid surfaces

The search for understanding the atomic structure and dynamics of solid surfaces under the influence of adsorbates (frequently molecules from the gas phase) dominated the research of Gerhard Ertl. Again and again he adapted or developed new methods and combined them in an exemplary manner, to extract “physically exact” statements.

One of the intensely studied reactions in Ertl’s working group was the oxidation of carbon monoxide to carbon dioxide on interim metal surfaces. Already in 1982 his group reports on kinetic oscillations in the  $CO_2$ -production along metallic single-crystal surfaces - a phenomenon that was observed, up to then, only in catalytic reactors.

In a set of pioneering publications, the group showed the connection between the adsorption of carbon monoxide and oxygen that causes a reconstruction of the surface. The reaction and the higher sticking probability of oxygen on the non-re-



▲ Gerhard Ertl receiving his Nobel Prize from his Majesty King Carl XVI Gustaf of Sweden at the Stockholm Concert Hall, 10 December 2007. © Nobel Web AB 2007. Photo Hans Mehlén.

constructed surface result in a switching between the reconstructed and non-reconstructed arrangements, and consequently to kinetic oscillations. This kind of oscillations can be regular, but can also become irregular or chaotic. These temporal oscillations represent the integral behaviour of the system. But we know from the well-established Belousov - Zhabotinsky reactions, that oscillations lead to topological structures.

## Femtosecond spectroscopy and Raman scattering

To display spatio-temporal structures on surfaces under reaction conditions, the working group developed a new photoelectron emission microscope, with which it was possible for the first time to show the temporally changing topological structures, like helices, chemical waves etc. Together with theorists these non-linear dynamic structures have been successfully modelled. If one is interested in the analysis of chemical processes on solid surfaces at atomic level, which means with the highest spatial resolution, it is obvious to concentrate also on the temporal resolution in the observation of dynamic processes. Gerhard Ertl founded a group within his department in the FHI that studies pump-probe experiments with lasers at a femto-second time resolution. These experiments led to deep insights into the electron dynamics during energy-transfer processes in chemical reactions after photo-excitation. An outstanding example of the new “old” method, besides the comprehensive electrochemical activities that were pushed by Gerhard Ertl, is the tip amplified resonant Raman scattering.

## Tragic loss for the Turkish Physics Community

We are deeply sorry to announce that on the 30<sup>th</sup> of november 2007, six physicists of the turkish physical society, **Engin Arik, F. Senel Boydag, Iskender Hikmet, Mustafa Fidan, Berkol Ozgen Dogan** and **Engin Abat**, died in a plane crash, on their way to a workshop on the turkish accelerator center project.

We have here some first clear indications from his group that the sensitivity can be brought to the single molecule level. From this, further important perspectives in many fields of the recent physical chemistry on surfaces could result.

There are many more aspects to be mentioned, but Gerhard Ertl's oeuvre is too extensive to go into details here: His list of publications contains more than 700 articles. Besides this, he presented hundreds of invited talks. A summary of personal information until 2004, the year when he formally retired, can be found in the Festschrift at the occasion of his 68 birthday. [*cp. Journal of Physical Chemistry B* **108**, 14183 (2004)].

The list of his awards is long: Liebig Medal of the German Chemical Society, Japan Prize, Wolf Prize, Otto-Hahn-Prize, honorary membership in the German Bunsengesellschaft and many more. About 40 memorial lectures and various honorary responsibilities within the scientific community testify the remarkable reputation and reliance that Gerhard Ertl enjoys.

And now the well-deserved coronation!

### From Stuttgart via Munich to Berlin

Gerhard Ertl was born in 1936 in Bad Cannstatt and studied physics in Stuttgart where he got his diploma in 1961 and wrote his dissertation with Heinz Gerischer who had been at that time at the Max-Planck-Institute for Metal Research. In 1965 he received his doctor's degree and went, together with his doctoral advisor, to the TU Munich, where he habilitated within only two years. After this, he accepted the call for a professorship for physical chemistry in Hanover. About 5 years later, he accepted a call to the LMU Munich. In 1985 he became successor of his teacher, Heinz Gerischer, as director at the Fritz-Haber-Institute of the Max-Planck-Gesellschaft in Berlin. He held this position until 2004, when he was given the emeritus status.

Gerhard Ertl is a wonderful colleague, friend and – since his retirement – advisor. His participation in the daily institute's life has changed, but only in the way that he retired as director of the institute. We are very pleased to meet him in the institute every day.

It is said that he very often stands in for the pianist during the choir rehearsals of his wife Barbara. He plays wonderfully the piano and the harpsichord. After the recently held Baker-Lecture at Cornell University he is now writing a book. The revised version of the second edition of the Handbook of Heterogeneous Catalysis is possibly almost finished. His activity is unbowed and we are sure that this will continue further on for a long time.

All colleagues, friends, students and collaborators congratulate Gerhard Ertl for winning the Nobel Prize for chemistry 2007 and share his happiness.

Congratulations and all the best wishes. ■

**Hans-Joachim Freund,**

This laudation has been written by Prof. **Hans-Joachim Freund**, a colleague and close friend of Prof. Gerhard Ertl. It was first published in German in "Nachrichten aus der Chemie" (Nov. 2007, p. 1075). It has been translated for Europhysics News with permission of EuChemS, the European Chemical and Molecular Sciences.

## CERN'S NEXT DIRECTOR GENERAL »» PHYSICS NEWS

On 14 December, CERN Council appointed Professor **Rolf-Dieter Heuer** to succeed Dr **Robert Aymar** as CERN's Director General. Professor Heuer will serve a five-year term, taking office on 1 January 2009. His mandate will cover the early years of operation and first scientific results from the Laboratory's new flagship research facility, the Large Hadron Collider (LHC). The LHC is scheduled to begin operation in summer 2008.

Currently Research Director for particle and astroparticle physics at Germany's DESY laboratory in Hamburg, a post that he took up in 2004, Professor Heuer is no stranger to CERN. From 1984 to 1998, he was a staff member at the Laboratory, working for the OPAL collaboration at the Large Electron Positron collider (LEP) research facility. From 1994 to 1998, he was the collaboration's spokesman.

"This is a very exciting time for particle physics," said Professor Heuer. "To become CERN's Director General for the early years of LHC operation is a great honour, a great challenge, and probably the best job in physics research today. I'm looking forward to working with CERN's community of personnel and researchers from around the world as we embark on this great adventure."

Professor Heuer obtained his doctorate in 1977 from the University of Heidelberg. Much of his career has been involved with the construction and operation of large particle detector systems for studying electron positron collisions. On leaving CERN in 1998, he took up a professorship at the University of Hamburg, where he established a group working on preparations for experiments at a possible future electron-positron collider. On taking up his

appointment at DESY in 2004, Professor Heuer was responsible for research at the HERA accelerator, DESY's participation in the LHC and R&D for a future electron-positron collider.

"Rolf Heuer has worked tirelessly for DESY as Germany's main particle physics laboratory, while at the same time strengthening links between DESY, the German University system and CERN," said Professor Torsten Åkesson, President of CERN Council. "This spirit of collaboration will be a valuable asset to CERN as we move into LHC operation, develop strategic options for the long-term scientific programme, and develop collaboration with the European national laboratories and institutes." ■

