# Press Release

Award for
Andrea Urban and Dr. Franz Lärmer
**Bosch researchers are**
**European inventors of the year**

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- EU Commission and European Patent Office present top award
- Recognition for pioneering process for manufacturing microchips

Andrea Urban and Dr. Franz Lärmer, two Bosch Group researchers, have been named “European Inventors of the Year” – an award sponsored by the EU Commission and the European Patent Office (EPO). The award was presented at a ceremony in Munich by Günter Verheugen, EU Commission Vice-President, and Alain Pompidou, EPO President. “This award is recognition of the far-reaching consequences of many Bosch Group innovations,” said Dr. Siegfried Dais, deputy chairman of the Bosch board of management, whose responsibilities include research and advance engineering.

The award recognizes inventors and innovations that have made a major contribution to technological progress in Europe and beyond – and thus also to strengthening Europe’s economic position. Urban and Dr. Lärmer developed a process that revolutionized the manufacture of the micromechanical components known as MEMS (micro-electro-mechanical systems). Without them, safety technologies such as the vehicle airbag would not be possible. The systems are also used in ESP, the electronic anti-skidding system, and in rollover protection.

**“Bosch Process” - a pioneering development in microsystems technology**

Urban and Dr. Lärmer’s development is a special plasma etching process for silicon. It was only as a result of this process that it was possible to mass-produce sensors cost-effectively. The process, now known commonly as the “Bosch Process,” is now indispensable for microsystems technology. Wherever they are produced in the world, nearly all MEMS are based on

Robert Bosch GmbH
P.O. BOX 10 60 50
D-70049 Stuttgart

E-Mail Andreas.Kempf@de.bosch.com
Phone +49 711 811-6285
Fax +49 711 811-7612

Corporate Communications
Vice-President: Uta-Micaela Dürig
www.bosch-presse.de

this process. The process has more or less completely replaced other processes, such as the wet etching of silicon in potassium solution.

The basic patent dates back to 1992, and has been constantly further developed and refined since then. Today, there are roughly 40 patent families associated with this technology, and more than 350 individual patents have now been granted. At the Bosch Reutlingen plant alone, more then 130 million sensors are produced every year using the Bosch Process. The signs are that this number will increase further, since these products are being used in more and more areas. Apart from the automobile, for example, they are used in mobile phones, laptops, or games consoles. Bosch will start construction of a new semiconductor manufacturing facility in Reutlingen this year. This represents a total investment of roughly 600 million euros. Start of production is planned for the beginning of 2009.

**More research and development expenditure**

In the Bosch Group, innovations are a top priority. Research and development spending came to 3.3 billion euros last year. This is the equivalent of 7.7 percent of sales, up from 7.4 percent in the previous year. A total of 25,300 men and women work in research and development at Bosch. More than 300 of them are involved in work on MEMS. Last year, the number of patents applied for rose by nine percent to 3,056. Of these patents, 36 percent related to environmental protection and resource conservation. Half of them will help to reduce fuel consumption and $CO_2$ emissions further.

**Press photos:** 1-PE-14146; 1-PE-14147; 1-AE-13629_2; 1-RT-13633_2; 1-RT-13636_2 can be downloaded at www.bosch-presse.de.

**Press contact:**
Andreas Kempf
0711 811-6285

*The Bosch Group is a leading global manufacturer of automotive and industrial technology, consumer goods, and building technology. In fiscal 2006, some 260,000 associates generated sales of 43.7 billion euros. Set up in Stuttgart in 1886 by Robert Bosch (1861-1942) as "Workshop for Precision Mechanics and Electrical Engineering," the Bosch Group today comprises a manufacturing, sales, and after-sales service network of some 300 subsidiaries and more than 13,000 Bosch Service Centers in over 140 countries.*

*The special ownership structure of the Bosch Group guarantees its financial independence and entrepreneurial freedom. It makes it possible for the company to undertake significant up-front investments in the safeguarding of its future, as well as to do justice to its social responsibility in a manner reflective of the spirit and will of its founder. A total of 92% of the share capital of Robert Bosch GmbH is held by the charitable foundation Robert Bosch Stiftung. The entrepreneurial ownership functions are carried out by Robert Bosch Industrietreuhand KG.*

*Additional information can be accessed at www.bosch.com.*

# MEMS and the “Bosch Process”

Bosch has been researching in the field of micro-electro-mechanical systems, or MEMS, since 1988. The company has already applied for more than 350 patents associated with these micromechanical components. Up to now, the MEMS manufactured by Bosch have been used above all in the automotive industry. These microchip components are the vehicle’s “sensory organs,” and include sensors for safety systems such as ABS, ESP, or the airbag, and well as for controlling the electronic engine management system or driver assistance systems. Some of these sensors, which comprise several chips, are far smaller than a fingernail. On average, between 100 and 200 of these control elements are installed in a middle or luxury-class car.

Mass production of many of these micromechanical sensors only became possible as a result of the “Bosch Process.” As a result of the plasma etching process developed in 1992, deep structures with vertical walls can be etched into silicon wafers with extreme precision and at high speed. Before this process, micro-structures such as these could only be produced on a metal base using the expensive “LIGA” (lithography, electroplating, and molding) process. For broad industrial applications, however, this process is far too complex and expensive. The Bosch Process made it possible for the first time to manufacture comparable highly complex structures in silicon using comparatively simple and cost-effective procedures.

In his book “Microsystem Design,” Professor Steven D. Senturia, a world expert in MEMS technology who teaches at MIT in Boston, writes: "The Bosch process is revolutionizing the development of micromachining processes and designs". Today’s microsystems technology is inconceivable without the Bosch Process. Nearly all the MEMS produced in the world are based on it. The process has more or less completely replaced other processes, such as the wet etching of silicon in potassium solution.

One example of a sensor based on MEMS technology is the SMB 360, a triaxial, universally applicable acceleration sensor that has been developed specifically for consumer electronics. It can be used in areas such as entertainment electronics, mobile phones, and computer technology, but also in the areas of security and medicine. The sensor can for example

trigger a radio alarm if someone falls or remains motionless on the ground, or if a notebook is removed without permission. Apart from acceleration sensors, Bosch also currently supplies a number of pressure and yaw-rate sensors.

In the Bosch plant in Reutlingen alone – the headquarters of the Bosch Automotive Electronics division – more than 130 million sensors are manufactured every year. And demand is increasing. This year, Bosch will start construction of a new semiconductor manufacturing facility in Reutlingen, with a total investment volume of some 600 million euros. Rollout of production is planned for mid-2009. The plant will be able to manufacture up to 1,000 silicon wafers a day, equivalent to a daily production volume of as many as one million microchips.

# Curriculum Vitae

## Dipl.-Ing. (FH) Andrea Urban

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Andrea Urban (née Schilp) has been responsible for the development of new generations of micromechanical sensors since 2003. At the Reutlingen location, the headquarters of the Bosch Automotive Electronics division, she is also responsible for the application of research findings to new production processes.

Andrea Urban was born in Waiblingen, Germany, in 1967. After leaving school in 1987, she studied Materials Engineering and Surface Technologies at the University of Applied Sciences in Aalen, taking her diploma examination in 1992. In the same year, she joined Bosch, working in its corporate research and engineering center.

The engineering graduate was the co-inventor of the “Bosch Process” for manufacturing micromechanical components. On the basis of this invention, she has developed more than 100 patented applications. She has successfully concluded a number of projects in the area of microstructuring, which have helped Bosch to bring a whole series of new microsensors to the market. Examples of such sensors include micromechanical acceleration and yaw-rate sensors, which are mass-produced at the Bosch plant in Reutlingen.

Part of this work has been done within the EU-funded projects “MAXIMA” and “SI_GYRO,” as well as within the European Commission’s Framework programs III and IV. This work has also involved coordination of the EU’s “I-SPEEDER” project, which has played a decisive role in driving forward advanced deep reactive ion etching in Europe.

# Curriculum Vitae

## Dr. Franz Lärmer

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Since 2003, Dr. Franz Lärmer has been the director of a comprehensive development project within the Bosch Group, whose aim is to extend the scope of application of microsystems to areas beyond automotive technology.

Dr. Franz Lärmer was born in Waldsassen, Germany, in 1960. After leaving school in 1980, he studied Physics at the Technical University of Munich and at ETH in Zurich. He was awarded several prestigious scholarships. He took his diploma examination at ETH in Zurich in 1986. He submitted his Ph.D. thesis on “Femtosecond Spectroscopy of Large Organic Molecules” at the Technical University of Munich in 1989.

In 1990, he joined Bosch, working in its corporate research and engineering center. At Bosch his work focused among other things on new microstructuring technologies and their application in the manufacture of novel acceleration, yaw-rate, and pressure sensors for various automotive applications.

Dr. Lärmer is the co-inventor of the “Bosch Process,” a plasma etching process for micromechanical components also known as DRIE (deep reactive ion etching), which has revolutionized microsystems technology. In this field, he has applied for roughly 40 patents. He has also been involved in the development of more than 150 further patent applications in the area of micromechanical technologies and components, of which more than 70 patent families have already been awarded. He has managed a number of development projects in this field.

Between 1997 and 2000, Dr. Lärmer was project coordinator of the EU-funded “SI_GYRO” project, part of the European Commission’s Framework Program IV. Subsequently, up to 2002 he managed the Bosch sub-project within the EU “SUMICAP” project, part of the EU Commission’s Framework Program V.