Oxford University, Department of Materials
Industrial Tour
Munich
14th – 19th March 2004

Markus Mittermaier, Mansfield College

Between these dates, a group of 21 Materials Science students (undergraduates and D.Phil. students) as well as Dr. Adrian Taylor, the Director of Studies, participated in an Industrial Tour centred on Munich. The aim of the tour was to visit various companies related to the field of Materials Science.

The Tour was planned and organized by me, Markus Mittermaier. I am currently in my second year as an undergraduate reading Materials, Economics and Management.

We received substantial financial support from the Worshipful Company of Armourers and Brasiers', Corus, Oxford University's Department of Materials, the Institute of Materials, Minerals and Mining and the Royal Academy of Engineering. We are all extremely indebted to these organizations for their contributions to the trip, which allowed me to lower the Tour cost for students substantially.

I would also like to thank Dr. Taylor, Mr. Barry Fellows and Mrs. Rachel Meyrick for their invaluable support.

Sunday, 14th of March 2004

The group met at the Gloucester Green bus station in Oxford to depart for Heathrow Airport. After a few hours at Heathrow and the one and a half hour flight to Munich, we settled in at the hotel. In the late afternoon there was enough time for me to give the group a short tour of Munich's city centre, which was followed by a Bavarian style dinner at the Hofbraeuhaus.

Monday, 15th of March, 2004

There were two visits.

The first was **Siemens Corporate Technology**, where the head of Technology Marketing at Siemens presented the Siemens corporate structure and explained both how the central research and development unit fits in and why it is so crucial for this global player.
After that general overview a Materials Scientist presented a talk on the work that Siemens is doing in the field of Materials Science. Among the many fascinating innovations was one with which barcodes used in the retail industry are to be replaced by OLEDs that do not require scanning. Cashiers will basically become redundant then.

In the afternoon we visited **EnOcean**, a start up company.
In the current entrepreneurial climate, there are an increasing number of spin out companies being formed to capitalise on novel and creative inventions. In 2001 a small group of Siemens employees decided to break away and form a company to design sensors based on the principle of utilising a small untapped source of energy available in the environment. The name EnOcean refers to this formally unused "Ocean of Energy". The main focus of the visit was a presentation of the principle of the sensors based on the piezoelectric effect, to enable the control of a device by using 868MHz radio waves. By mechanically pressing a button a piezoelectric crystal based sensor produces a small electrical current. This can be used to emit a coded radio wave signal, which is detected by a

receiver built into a device. One application is wireless control of lighting (on/off and dimmer functions)The range over which the device can be controlled is currently up to 300m. The nature of this small start-up company allowed us direct contact with the CTO. The questions and answers were candid, which would not have been possible elsewhere. This unprecedented insight into the nature of such an organisation was very much appreciated by all. It was nice seeing first year and Ph.D. students discussing the future of the company afterwards. The opinions ranged from “this is going to be a big player soon” to “I don’t see how they can make it over the next year”.

In the night the group visited the Munich Olympic Park and enjoyed the magnificent view of the city and the alps as well as the sunset from the top of the Olympic tower.

Tuesday, 16th of March, 2004

Osram Opto Semiconductors
The new Osram Semiconductor Fab is in Regensburg, which is about one and a half hours north of Munich. It is one of the most modern semiconductor fabrication plants in the world. I organized a coach for that trip and we left Munich after breakfast. Osram Opto semiconductors is a division of Siemens which produces lighting products with their three main areas being illumination, sensing and visualisation. During the presentation we learnt of the development of organic light emitting diodes (OLEDs) to replace current LEDs. OLEDs are potentially extremely useful because they have high brightness, high efficiency and a fast response time. Especially interesting was the fact that Osram managed to develop an “almost white” LED. After a presentation by the human resources director and two researchers we viewed the clean labs (wearing appropriate protective clothing) where processes such as photolithography were demonstrated and had a tour of the associated plant for the fabrication process.

After this very interesting trip which was an ideal extension to the semiconductor courses offered in the second year, the group had lunch with OSRAM employees and afterwards we left to explore the city of Regensburg which used to be one of the most important cities in central Europe in the middle ages.

We returned to Munich in the evening.

Wednesday, 17th of March 2004

Alcan Automotive

Alcan Automotive produces aluminium parts for the car industry. After the CEO welcomed us we listened to a company presentation and an overview of several casting technologies. Subsequently, we were shown around in their production site where they use the technology of high pressure die casting to produce parts for Audi, VW and Daimler Chrysler. We also heard that they are involved in the development of a new Jaguar car which is to enter the market in a few years.

This visit was very different in character to the previous ones because the nature of Alcan’s business is very different to the firms we visited on the first two days. However, it was equally interesting and students entered a long discussion about Alcan’s product line and developments while enjoying the Bavarian style brunch with white sausages and Bavarian pretzels offered by Alcan (certainly an experience for some!).

In the evening the group enjoyed a lovely **tour dinner** in the Rathaus Kellar – a great evening together.

Thursday, 18th of March 2004
This day was the free day. Most people visited the Neuschwanstein Castle in the Alps. Two students decided to stay in Munich in order to visit the BMW museum.

We had a fantastic time in Munich. It opened our eyes to the wide range of opportunities a degree in Materials Science offers and how important the subject is considered. The whole group would like to thank everyone who helped make this tour possible. I think it was a great achievement and hope that you will continue to support such tours in the future.

Student Feedback
In order to get some student opinions about the tour I did a feedback survey. The students were all fascinated and very happy about the tour. In the following I give you small selection of representative feedback:

"The trip was overall very informative, with first-hand experience in what Materials graduates may undertake after their degree, especially on encountering the very people who made these companies work. The presentations and tours of factories were well-planned, giving the group of us a better understanding of what goes on in Materials-related companies. We had a chance to question and discover the in-depth structure and materials-based ideas these companies were founded upon - a rare opportunity for many departments."

"The best part of the trip was the balance between experiencing the Munich culture and the career/working side [… as well as …] meeting the Executives of Siemens, Osram, EnOcean and Alcan. Having the opportunity to meet such influential people with interesting ideas was also another definite highlight."

“The 2004 Industrial Tour of Munich provided a unique insight into the numerous challenging applications of materials science and enabled theories from the lecture theatre to be converted to goods off the production line.
The area of innovation that most fascinated me was the description of how barcodes used in shopping are to be replaced by OLEDs that do not require scanning. I found this interesting because of the commercial benefits by reduced labour and customer satisfaction (potentially, no more queuing). Materials technology truly is the driving force of the 21st century economy.”

“I was very impressed by the relevance of our lecture courses (semiconductor theory/devices, and aluminium processing) to the information that was given in presentations and visits at the numerous companies we visited. It brought me a much wider picture of the economics of this world, and how materials science fits into this, in terms of R&D, profits and markets.
As a small scale, spin off company (from Siemens) I found EnOcean the most interesting, not only for the economical use of materials science but also due to the explanations of its management structure and the mechanisms by which it separated from Siemens. It was intriguing to discuss its hopeful future.“

“Best bit of the trip:
The tour dinner was the zenith of the trip since the food was excellent and everybody was in great company and good form.
Best bit of the industrial visits
The drinking duck owned by EnOcean was certainly appreciated but their devotion to utilising unused energy made a real impression upon me.”