

# Bede's focus points to millennium success

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Celebrating its 20th anniversary this year, Bede Scientific Instruments has established a reputation as a world leader in X-ray diffraction. Far from resting on its laurels, however, the company is actively developing new products and applications at its headquarters in Durham, UK, and its new US subsidiary in Denver, CO, USA.

Among the pioneers of high-resolution X-ray diffraction (HRXRD), Bede Scientific Instruments has become well known throughout the compound semiconductor industry. It has sold many HRXRD systems worldwide, a mixture of both quality control units and flexible R&D systems. These systems range from the microwave sized QC1<sup>a</sup> to the floor standing QC2<sup>a</sup> (Figure 1) for the production-oriented, to the versatile D1 and ultra-high resolution D3 (Figure 2) for organizations seeking to probe the unknown as well as perfect their current products. Bede also

produces Lang topography cameras for the manufacturers who are serious about wafer process development and screening.

Over the years Bede has also demonstrated a high commitment to their software development, as is evident with its recently launched suite of analytical software 'Bede Lab'. One of the most important developments in this suite of software is its new software for diffraction and reflectivity data. This new software has been optimized for Bede Mercury, auto-fitting, Bede's RADS (Rocking-curve Analysis by Dynamical Simulation) and REFS (Reflectivity and Fluorescence Simulation) programs.

With the compound semiconductor industry firmly in growth mode, Bede itself is enjoying the benefits of its past labours and the current market prosperity. This is underlined by its recent opening of a US subsidiary, Bede Scientific Inc in Denver, CO, and its planned move of both the headquarters and subsidiary to expanded premises in 1999.

While expanding sales of its present product line is a priority, Bede is also looking further into the future. Foremost among Bede's latest innovations, is its 'microsource<sup>®</sup>' X-ray generator. Launched in July of this year, after successful test marketing during 1997, this low power, compact generator is the world's first X-ray

generator designed specifically to take advantage of novel focusing optics. It represents more than three years development, in collaboration with leading researchers and institutions in the field of advanced electron optics and X-ray generator design. The revolutionary microsource generator produces X-rays using a magnetically focused electron beam that may be electronically controlled in terms of focal spot, position and profile.

Bede, through its Czech Republic-based subsidiary company Reflex s.r.o, has developed X-ray optics specifically for use with the microsource. Dubbed 'micromirrors', the optics exploit the well-established principle of using an ellipsoidal X-ray mirror to collect X-rays from a closely couple source. The mirrors have an inner diameter of less than 2 mm, an internal roughness of less than 1 nm and a shape accuracy better than 1 µm. Bede says Reflex is the first company in the world to overcome the technological barriers required to reliably produce such small mirrors. "The best analogy is that the micromirror has an internal profile similar to the shape of a sewing needle," says the microsource Commercial Manager, Dr Graham Fraser.

According to all current testing, the microsource running at 30 W, using micromirror optics, can deliver a beam of equivalent brightness to that of a rotating an-

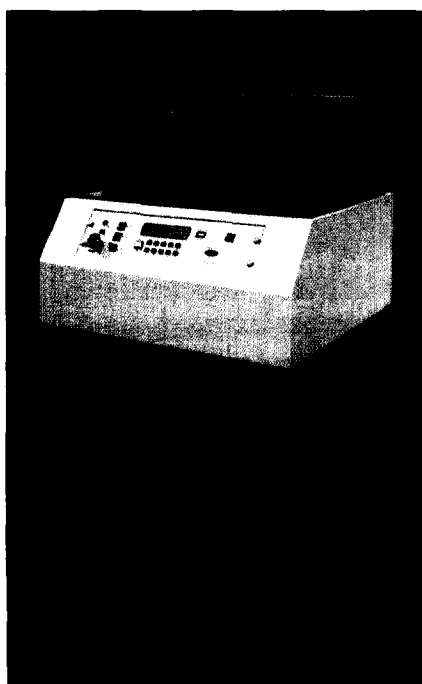


Figure 1. Bede's QC2<sup>a</sup> is designed for the production oriented.

## Bede's saintly past boosts a fledgling company

Necessity has long been recognized as the mother of invention and it certainly played a key role in the birth of Bede Scientific.

The company's origins date back to 1978 when four staff members from the Physics Department at the University of Durham, UK, got together to build a magnetometer. The consortium came together simply because no one else was making the necessary instrument, which was duly built and holds the honour of being Bede's first order.

Among the 'Fab Four' was Professor Brian Tanner, one of the founding members of the company and now Bede's Science Director. Tanner recalls the company's big break came in the middle of the following year at a NATO Advanced Study Institute held in Durham. "Steve Groves of MIT Lincoln Laboratories, a user of high-resolution double axis diffractometers, approached me and said, 'Where can I get one of these'," Tanner recalls.

Soon, word spread of the group's achievements and Bede began sub-contracting mechanical engineering work from a company, Altec Engineering, set up by one of the founders six months earlier. The company was on its way.

The company takes its name from the 'Venerable Bede', a scholar who lived in the late seventh century, and who is buried in the world-famous Durham Cathedral. In the course of his works on

chronology, he invented a system of reckoning dates - Anno Domini or AD - that is still used today. It may well have been fortuitous that Bede chose to name itself after a saint, because its earliest business links suggested an untimely demise. Altec Engineering was based in an old abattoir outside Durham and soon Bede took over the old mortuary and funeral parlour next door!

In these unlikely surroundings, the company grew for a decade before moving to its present location in Bowburn just outside the city of Durham. Now the company is planning to move premises to a larger location in Durham.

Another important chapter in the company history began in 1996, when its US subsidiary, Bede Scientific Inc, opened for business. With a large percentage of its sales in North America, the move reflected the need to offer a comprehensive range of services to the region.

Based just outside Denver, CO, the US office is responsible for sales, service and applications support for the USA, Canada and Mexico. Bede Scientific Inc also has responsibility for developing all of the scientific and analytical software for the group.

Dr Keith Bowen, Bede's strategic research director, has been seconded to the US operation as its first president. Formerly Professor of Engineering, and Director of the Centre for Nanotechnology and Microengineering, at the Uni-

versity of Warwick, UK, Bowen has an extensive pedigree in X-ray science. He is author of more than 125 scientific publications, and is a Fellow of the Royal Society and the Royal Academy of Engineering in the UK.

Bede Scientific runs several short courses annually around the world, designed to familiarize users with the theory of the X-ray scattering involved, the operation of the equipment and the interpretation of practical data. This gives their customers an opportunity to work side-by-side with, as well as learn from, some of the top scientists in the industry. From the managing director Neil Loxley to service manager Tony Beddard, Bede believes that one of its greatest strengths is in the high quality of people it employs.

Bede Scientific's goal is not to simply provide a product, but to advance the industry. They do this by working closely with the industry to ensure that people get what they want. Bede has an extensive history of world firsts for products, and often collaborates with other companies. Their scientists are widely known and they publish often - Professor Brian Tanner and Dr Keith Bowen have just published their long awaited book *High Resolution X-ray Diffractometry and Topography*. Through these and many more activities Bede is able to stay close to the market and identify emerging market opportunities, as is evident by the last 20 years.

ode generator running at 5 kW with mirrors. It is the size of a desktop machine and ushers in whole new areas of applications. The company has already begun exploring the system's applicability to a range of market's outside its traditional home-base in the

compound semiconductor industry, including its use for X-ray phase contrast imaging of composite materials and biological samples, and as the basis for powder diffraction experiments.

"There has been a great deal of R&D work carried out to develop

better detectors for XRD, but we've been paying a lot of attention to the other end of the business - the source," says Fraser. "XRD is on the first stage of its own miniaturization revolution, similar in concept to the shift from mainframe computers to

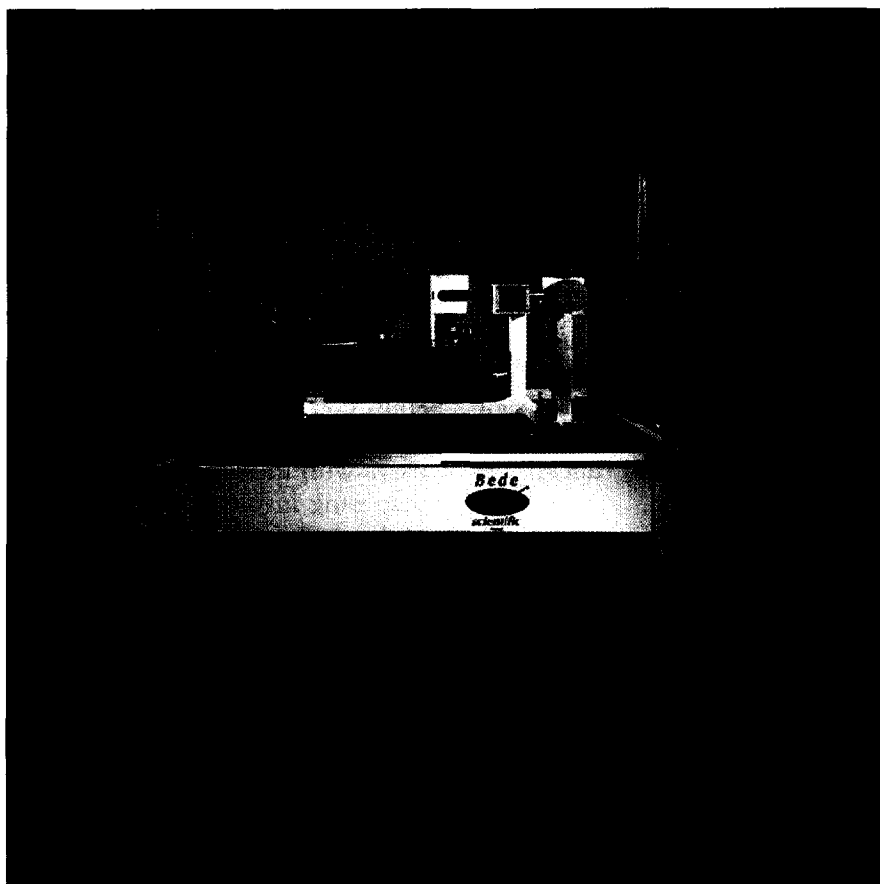


Figure 2. The D3 is aimed at the scientific community.

desktop PCs. With the **microsource**, we have the ability to do it now, particularly with the complementary work going on with detectors."

Such is Bede's confidence in the future of the **microsource**, and the fact that it expects the system to take it into new markets, that the company has established a new division dedicated to it. Which means Bede's activities are now divided into three divisions - **microsource**, analytical instruments and software, and Reflex s.r.o.

And indeed, the **microsource** has already chalked up some notable achievements in the short time since its development. It is already being used in a prototype XRD system with the intention of being developed for crystal growth experiments to be performed on the proposed International Space Station - quite a product launch! It has also been selected as an UK 'millennium

product' and is featured on the Millennium website.

Already having made an important contribution to the development of the **microsource**, Bede believes its development of advanced X-ray optics will play an important role in its future. "For the past five years we have been investigating advanced X-ray optics, both in compound semiconductor and other applications," Fraser says. "It is an area that is going to be increasingly important, optics are going to revolutionize the characterization of materials by X-ray methods."

## The rise of Reflex

Bede's forays into this area led to the formation in 1997 of Reflex, a joint venture with leading researchers from the Czech Republic whose background was developing optics for the Soviet space programme. The company has considerable experience in the

production of extremely accurate and smooth surfaces of different geometries, including foils and flats. It has also developed a set of advanced computer programs, which enable the performance of X-ray optics to be accurately modelled.

Bede has been very successful in recognizing and commercially developing science pioneered in the former Communist Bloc. In addition to Reflex, the company has just released a software package, 'Bede - ZDS', produced in co-operation with scientists from the Czech Mineralogical Survey. Launched in August of this year, Bede - ZDS is 'search-match' software that enables Bede's characterization equipment to be used as turnkey systems - once a sample is analysed, the software informs the user not only what material it is, but also what crystalline phases are present and in what concentration.

Fraser attributes the company's success in finding these partners as stemming from its strong technological focus. "One of the strengths of Bede is the very high level of scientific knowledge within the company; we have a number of industry experts," he says. "The philosophy of the company reflects not only an interest in our business, but also a passion for the science that underpins it."

With a solid background and a clear vision for its future, Bede seems well placed to continue to build on its current success.

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