Background

QED Technologies, Inc. has dramatically changed the landscape of precision optics manufacturing. In 1998, QED commercialized the first fully automated system to deterministically polish optical components to levels of precision and surface finish that previously were considered impossible. QED's automated polishing machines use a magnetically sensitive (or magneto-rheological) fluid to polish optics in minutes or even seconds, replacing the artisan-based, labor-intensive technology that previously took weeks or even months. Magnetorheological finishing (MRF) enables the fabrication of "normal" optics (e.g., spheres, flats and prisms, etc.) as well as unusually shaped lenses and mirrors known as aspheres, at a fraction of the cost of traditional methods.

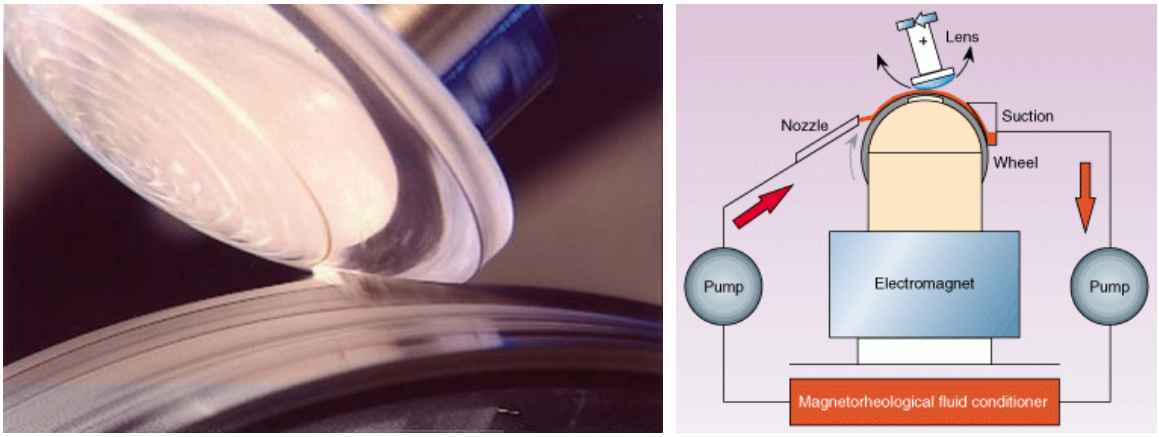

Figure 1. "MRF represents one of the single most exciting advances in optical fabrication in many, many years." -- *Photonics Spectra*, 1993.

QED's contribution to asphere manufacturing represents an important breakthrough for the optics industry. Traditionally, aspheres have been difficult and expensive to manufacture because of their unusual shape. A single aspheric optic can cost up to several tens of thousands of dollars with unpredictable production times and yields. These considerations have limited the widespread use of aspheres, despite their ability to deliver improved optical performance and image quality over traditional spherical lenses. A cost-effective, reliable

asphere manufacturing process has implications for a wide range of consumer products including compact disc players, photocopiers, projection televisions, telescopes and camcorders. Beyond the consumer realm, aspheres are used in many applications, including night vision goggles, professional movie cameras, surgical lasers, endoscopes, scanners.

History

MRF was first developed by a team of scientists led by Dr. William Kordonski at the Luikov Institute of Heat and Mass Transfer in Minsk, Belarus in 1986. Kordonski and his team initially studied the MR fluids for use in shock absorbers and clutches for soviet military vehicles, however they eventually developed the polishing application.

In 1991, Lowell Mintz, the founder of Byelocorp Scientific, Inc. (BSI), a New York-based firm that specializes in transferring technologies developed in the former Soviet Union, connected with Kordonski and recognized the potential of MRF. Mintz sought a development partner in the United States and was referred to Harvey Pollicove, Director of the Center for Optics Manufacturing (COM) at the University of Rochester. Although this radical approach sparked skepticism from the optics industry, Pollicove's team was impressed. A collaboration between BSI and COM was launched to demonstrate that MRF could become a viable precision finishing technology.

Under the new collaboration, Kordonski came to Rochester to work with the COM team to perfect MRF. The team spent the next three years studying and refining the technology, as well as demonstrating that this radical idea could produce real results. The once skeptical optics industry began to believe in MRF. However, a commercialization plan for MRF did not yet exist.

In mid-1996, Donald Golini recognized the opportunity, approached BSI, and wrote a business plan. BSI agreed to license the MRF technology to the new company and QED Technologies was created. MRF pioneers including Kordonski, joined QED and in 1998, QED introduced the Q22 MRF System - a multi-axis, computer-controlled machine that was capable of polishing optics up to 200mm in diameter. Today, QED offers a family of MRF machines, has an intellectual property portfolio of over a dozen fundamental international patents, and has sold more than 80 machines worldwide. QED succeeded in the challenging task of transforming a novel university R&D technology into a robust optics manufacturing product with broad commercial acceptance.

Figure 2. The Q22-Y MRF system is QED's flagship machine, enabling the manufacture of precision optics while reducing overall production time, increasing yield and reducing costs.

Situation Analysis

The collaboration at the University of Rochester was instrumental in the creation of QED Technologies. In 1990, COM was founded with a grant from the US Army to develop automated processing technologies to help optics manufacturers become less dependent on expensive, artisan-based labor. With a focus on determinism and automation, optics manufacturing becomes less sensitive to labor costs, creating a more level global playing field.

Donald Golini, a University of Rochester graduate, became affiliated with COM while working for Litton-Itek, an optics company outside of Boston, MA. In 1992, he was recruited to join COM full-time to manage the research in grinding and polishing process innovations. In a relatively short time, the group improved the state-of-the-art in grinding optics; however, the final polishing step was still expensive, time consuming, and required the “black art” expertise of the master optician. Fortunately, by 1996, it became clear that the MRF process would work and soon, Golini had sufficient funding to get QED Technologies running with 5 employees.

With the opportunity to start a new business, Golini, a Massachusetts native, anticipated relocating back to the Boston area. However, in a side-by-side comparison, it turned out that Rochester had a lot more to offer. The prohibitive cost of residential and commercial real estate in Boston was the first disadvantage of relocating. Leaving the quality public schools in the

Rochester area was another drawback. These factors, and the quality of life decisions associated with the prospects of long commutes and much higher living costs in Boston, helped Golini decide to keep the company in Rochester. Moving back to Boston would simply require too many personal and corporate compromises.

Rochester's international reputation for optics manufacturing was also a part of the decision. There were significant benefits in locating QED within close proximity to COM and the Institute of Optics, world leaders in optics technology development. Rochester's established optics industry and reputation would also draw optics traffic, and potential customers, to the city.

QED saw relatively rapid sales growth and needed to expand its workforce to keep up with demand. QED found a highly skilled and educated workforce in the Rochester region due to the presence of Eastman Kodak, Bausch and Lomb, and Xerox. Over 80% of QED's workforce, including non-technical staff, comes from area companies or are graduates of local universities. From QED's perspective, there isn't a better place than Rochester to find such a highly trained and multidisciplinary workforce. QED has been able to capitalize on the area's academic and industrial strengths in precision optics and engineering. Staying in Rochester turned out to be the best early decision the fledging company could have made.

Conclusion

QED Technologies has earned a place at the forefront of the optics industry with world-class products and a loyal customer base. QED's goal is to maintain its dominant position in the precision optics market by expanding foreign distributorship, sales and service, and continuing to invest significantly in R&D and product development. QED operations have extended overseas and now include a branch office in Osaka, Japan that will help QED to meet the customer service and support needs of its Asian customers and contribute to its on-going Asian growth.

In recognition of significant achievements, QED has been awarded many industry and military awards, including the Department of Defense Manufacturing Technology Achievement Award. Industry acclaim has been accompanied by broad commercial acceptance and QED has become one of the fastest growing privately-held companies in Rochester for three years running. In 2002, QED was fourth on the list of the top 100 companies.

Future plans involve expanding into new markets and several new business development opportunities are being explored, including applications in microelectronics, ophthamlics and

micro-optics. These markets are significantly larger and have higher growth potential than QED's current optics market. And this is just the start of QED's long-term strategy of successfully developing value-added solutions for customers with a variety of precision finishing needs. In just a few years, QED has established itself as a company that can provide critical solutions to many of the leading technology companies in the world and that reputation won't change as it expands into new markets.