Materials Systems Inc. (MSI)

The distinctive broadband capability of piezocomposite acoustic technology, once the domain of the ultrasonic non-destructive testing community, is now being made available to underwater sonar system developers on a much larger scale due to a Massachusetts company founded by an innovative scientist with an entrepreneurial spirit.

During the 1970s, when Dr Les Bowen was doing his postdoctoral work on piezocomposite acoustic materials at the Pennsylvania State University for the Office of Naval Research, piezocomposite was proving to possess attractive wide-bandwidth properties for sonar and ultrasound. The ability to manufacture the material in anything other than small quantities restricted its use to scientific instrumentation. When Bowen began developing injection moulding technologies for industrial ceramics production, the manufacture of piezocomposite material in large volumes for a wide range of acoustic applications became possible. His concept turned into reality when, in 1991, he established Materials Systems Inc. (MSI), a Massachusetts-based high-technology manufacturing company. Within a very short time, MSI’s patented fabrication process captured the attention of the US Navy, which began to explore ways to exploit the extended bandwidth that piezocomposite transducers could provide to sonar systems installed on surface ships, submarines and other underwater vehicles. Today, MSI is a full-service, ‘concept-to-production’ acoustic transducer development and manufacturing company that is focused on helping commercial and governmental clients to maximise the performance of their sonar systems.

The Challenge

In the 1980s, non-destructive testing system developers around the world realised the benefit of integrating wide acoustic bandwidth capability into their ultrasonic flaw detection systems. This enabled ultrasound engineers to employ complex signal processing techniques for detecting small objects with clarity and consistency. The enabling technology was piezocomposite materials that set new performance standards. As beneficial as piezocomposite proved to be in acoustic sensing and imaging, it was difficult and costly to manufacture in significant quantities.

MSI overcame this limitation in the early 1990s by developing an injection moulding process for making piezocomposite material in large sheets and blocks. Several R&D organisations took an interest in determining whether or not the technology would also enable sensitivity, resolution and range performance improvements in larger, higher powered acoustic systems, such as underwater sonars. A lengthy learning curve followed. Both the client and MSI’s engineering staff determined how to best exploit the advantages of the composite material in a variety of underwater applications.

The Solution

MSI gained a significant base of technical knowledge with respect to the performance expectations and technical requirements of sonar system manufacturers. As a result, the company decided to specialise in the custom design and development of broadband acoustic transducers for integration into existing and future sonar systems.

Having the ability to injection mould its transducer elements has also helped to open an entirely new and unique market niche. Intricate, curved elements and arrays that were technically unfeasible when using monolithic ceramic material could now be easily and economically fabricated. The company has delivered an impressive assortment of broadband transducers for applications such as mine-hunting, object avoidance, seafloor survey and underwater communications to both military and commercial clients internationally.

MSI has the ability to optimise the transmit and receive properties of the piezocomposite material that it produces for clients’ specific sonar applications. In addition, MSI engineers utilise a portfolio of proven computer models and a suite of design tools to meet stringent sonar mechanical and acoustic performance requirements. MSI’s automated in-water test facility allows each transducer to be fully tested prior to shipment to the customer.

MSI has invested heavily in its manufacturing and quality systems and has gained a reputation as a reliable supplier of both transducers and arrays in high and low volumes. In 2007, MSI received ISO 9001:2000 certification for both its engineering and manufacturing processes.

A Bright Future

MSI continues to be involved in extending the state-of-the-art for sonar transducers and arrays. The company has recently been funded by the US Navy to help bring piezoelectric single crystal technology to the point where it can be incorporated into next-generation Navy acoustic sensors and systems.

With the company’s technology being widely accepted, Dr Bowen looks forward to continued success: “The future of sonar is broadband. MSI’s technology and vertically integrated manufacturing enable us to deliver state-of-the-art products on time and in high volume. This capability positions us well for continued long-term growth in this exciting market.”

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