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Oct. 23, 2024 - ACS MEDIA RELEASE: Dr. Shelby F. Nelson, Co-founder and CTO of Mosaic Microsystems Selected as *2024 Entrepreneur of the Year* by the Rochester Section of the American Chemical Society

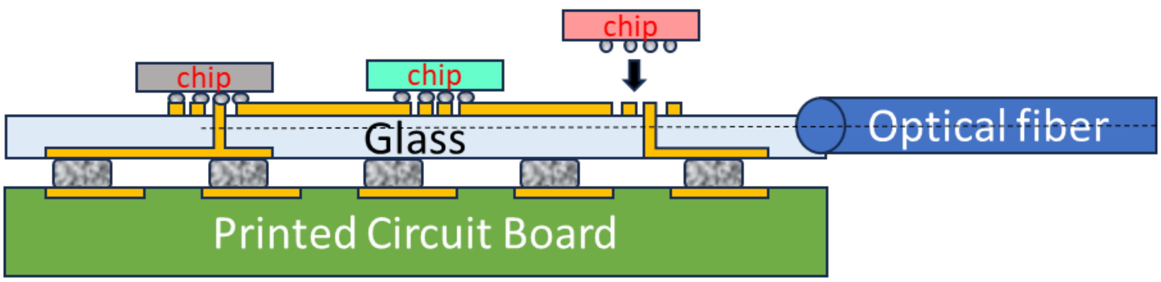
The Rochester Section of the American Chemical Society has selected Dr. Shelby F. Nelson, Co-founder and Chief Technology Officer of Mosaic Microsystems as its 2024 Entrepreneur of the Year. This award is presented in recognition of her co-founding Mosaic Microsystems (www.mosaicmicro.com), and developing and commercializing innovative glass packaging technology for integration of microelectronic and photonic chips. She will be recognized at the Section's Annual Recognition Dinner to be held on October 24, 2024. This award, in addition to recognizing her impressive technical and business achievements, highlights the continuing central role of chemistry and material sciences in the economic development of the Rochester area.

Shelby Nelson was born in Ethiopia and spent her early years in East Africa. After many moves for schooling and career, she has been a Rochesterian since 1999. She received a B.A. in Physics and Mathematics from Smith College. She then spent a year as a Senior Technical Associate at the AT&T Bell Labs working on ferroelectric materials, before receiving a PhD in Applied Physics, with a specialization in Materials Science, from Cornell University (1991). After a two-and-a-half-year Postdoctoral Fellowship at the IBM T. J. Watson Research Center, where her work focused on electrical transport in silicon/germanium heterostructures, she spent six years as the Clare Boothe Luce Assistant/Associate Professor of Physics at Colby College in Waterville, Maine. In 1999 she joined the Xerox Research Labs in Webster, NY as a Device Physicist, where her work centered on modelling a silicon mixed-signal CMOS process for ink-jet ejector heads. In 2001, she began a 16-year career at the Kodak Research Labs where she worked in the areas of thin-film and printed electronics. With this impressive academic and industrial research career, including 65 patents, she jumped into a promising new business opportunity using glass substrates for advanced microelectronics packaging, beginning a new career chapter as an entrepreneur. With Christine Whitman, Andrew Peskoe, and Paul Ballentine, she co-founded Mosaic Microsystems in 2016. Mosaic's proprietary glass handling technology allows temporary bonding of thin, flexible glass to a rigid handle wafer, to enable high-yield manufacturing of electrical and optical traces and circuits, leveraging industry standard processes normally used for silicon. This technology works with glass even below 100 microns thick.

Shelby's shift from industrial research into a tech start-up came late in her career, and she wishes she had made the leap sooner. She enjoys the sheer variety found in the challenges of building a business from scratch. Benefitting from Mosaic's participation in the Rochester Luminate business accelerator as a runner-up in the first cohort, and from collaboration with experienced serial-entrepreneur and Mosaic CEO, Christine Whitman, Shelby rapidly learned about the business side of a company. The intersection of technology with growing a business creates a stimulating and demanding environment.

Mosaic was founded on an understanding of the benefits provided by glass for advanced semiconductor packaging. Glass can be thought of as a very high-performance printed circuit board (PCB) -- enabling cutting-edge applications to meet their challenging targets. Mosaic's early understanding of the value of glass has been underscored by recent announcements by companies like Intel and Samsung of a drive to incorporate glass in their advanced packaging. Mosaic's special expertise is in the production of thin glass packaging solutions, with successful (high yield) handling of the floppy and transparent material through the many steps required to produce finished packages.

An example of how thin glass can be used in semiconductor packaging is shown in the schematic below. Often called an "interposer", the glass serves as a platform for fine and dense interconnection between semiconductor chips or chiplets, along with connections out to the PCB (thus "interposing" between chip and PCB). Many layers of metal routing are simplified in the drawing for clarity. Connection from the front to back of the glass is accomplished by fine metal-filled vias, another specialty of Mosaic. The transparent nature of glass opens potential for integrating optical signals with the electrical ones. This kind of "integrated photonics" enables lower power, higher speed connections for demanding applications like artificial intelligence. As shown in the schematic, optical fibers can bring signals to, and through, the glass, connecting to receivers that translate the signals in light into electrical signals.



Schematic image of semiconductor chips being assembled onto a glass "package", or interposer, which in turn is assembled to a printed circuit board. The glass allows much smaller and tighter-pitch connections to –and between– the chips. Glass also allows photonic signals (information carried at the speed of light) to be integrated with the electrical signals, as indicated by the optical fiber attached to the glass. Mosaic fabricates the high-performance glass interposers in their cleanroom fab in Rochester.

Prior to Mosaic having its own production facilities, Shelby defined and executed a technology transfer from a Fortune 500 company, ensuring that key elements of Mosaic's base technology were in place. She then found cleanroom space to begin product development and manufacturing, locating an excellent facility in the Eastman Business Park. Semiconductor fabrication is expensive but she was able locate a mix of used equipment and negotiate excellent prices, allowing the operation to begin well equipped but with relatively low capital investment. Throughout this period and beyond, she and the Mosaic team have supported the funding of the company through government contracts, including seven Small Business Innovation Research (SBIR) grants, and most recently a $1 million award in the Defense Business Accelerator (DBX) Microelectronics Challenge. This strategic initiative, aimed at revolutionizing how the Department of Defense catalyzes commercial U.S. technology development, is a significant milestone for Mosaic Microsystems' advanced microelectronics packaging technology. Such contracts, highly competitive and evaluated by world-class experts in the field, have not only provided critical financial support for Mosaic's early product development, but also provided validation of Mosaic's innovative and commercially viable technology. Another key factor in the company's success has been the rich pool of highly skilled technical talent in chemistry and device fabrication in the Rochester area that allowed Mosaic's product vision to become commercial products in a relatively short time from the founding of the company. After acquiring the cleanroom space in early 2019, Mosaic began shipping the first products in the same year. The market applications for Mosaic Microsystems' substrates span a broad spectrum of domains, including RF, computing, integrated photonics, and biomedical devices. Mosaic is prototyping thin glass with multi-layer interconnects, along with copper-filled through-glass vias connecting front to back of the glass, and is rapidly moving these to production for both defense and commercial industries.

Dr. Nelson has skillfully guided the company from its founding through several critical phases to its current position as a recognized leader for integration of semiconductor chips with glass substrates. As Dr. David Levy, an early Mosaic employee and a former co-worker at the Kodak Research Laboratories, has stated, Mosaic has thrived due Shelby's essential contributions, at all technical and business levels

More About Applications for Mosaic Microsystem's Glass Packaging Technology

RF. Wireless communication is pervasive in our society as we use our mobile devices to connect and control more and more aspects of our everyday life. This drives a huge appetite for increased communication speeds and data storage. The emergence of 5G / 6G including mmWave communication drives the need for new solutions that can perform at higher and higher frequencies. Thin glass provides solutions to address these challenging needs. Glass is inherently a low loss material and can be formed with low roughness and thin, large area formats. This makes glass an ideal substrate to provide thin, cost-effective solutions for next generation RF needs.

Package Substrates. There is an ongoing need for interposers for digital applications that require high bandwidth, low latency, and low power, allowing for tight electrical integration of a package with fine pitch lines and through vias to connect multiple heterogeneous top chips to each other and to backside components. These packaging solutions need to be thin to address the form factor needs of current devices. Thin glass is formed with sub-nanometer roughness and in formats > 1 meter in size. Furthermore, glass is stable with temperature and humidity, and the composition can be chosen to have thermal expansion properties to manage the stress in the package. Since glass can be formed thin (100 um and below) and in large formats, cost-effective solutions are available. Mosaic's proprietary handling solution makes these solutions possible.

MEMS. MEMS (microelectromechanical systems) devices have become pervasive and essential for applications including devices for micro-fluidics, switches, transducers and optical sensing. These devices do everything from lab-on-a-chip bioassays, to sensing the tire pressure in our automobiles to enabling the functionality of mobile phones and wearable devices. Glass plays an important role in many of these applications. The transparency and chemical inertness of glass is important for many optical and biological applications. Since glass does not absorb water and is very smooth, it provides an attractive solution for hermetically sealed microelectronic devices.

Sensing. Optical sensing has become pervasive in automotive, mobile communications, and life sciences /medical diagnostic applications, and generally for the Internet of Things (IoT). Glass has traditionally been an excellent substrate for both additive and subtractive structuring of glass surfaces. Being able to additively process directly on thin glass substrates avoids expensive post-processing steps. Mosaic's thin substrate handling technology provides a cost-effective way to fabricate precision sensing components on thin glass substrates.

Photonics. Our increasingly connected world creates a need to continually establish solutions for higher data rates and manage immense amounts of data in the cloud. Photonics provides increasingly important solutions to address these challenges. Glass has a number of advantages for photonic applications. It is transparent at wavelengths used in fiber optics and optical waveguides can be fabricated with lasers or thin films on or below the surface. Further advantages are seen in assembly since fibers can be attached directly to the glass substrate using laser fusion.

The Rochester Section of the American Chemical Society is the professional organization of some 800 chemists, biochemists, and material scientists in the six county Rochester area. For further information on Section programs and upcoming events see: www.rochesteracs.org.