



**Instruments for Innovation®**



[www.matsdev.com](http://www.matsdev.com)



## Mission

At MDI our mission is to provide the highest quality instrumentation, materials development, and technical support services to clients who need to process materials in extreme, non-equilibrium or non-contact environments. We work with clients in the glass, ceramics, pharmaceutical, and cosmetics areas at university, industrial and government organizations in the US and internationally. MDI's scientific and technical expertise sets us apart, allowing our team to solve difficult materials handling and processing problems. The solutions we develop and implement add value to our customers' existing products and accelerate the realization of new, competitive products.

## Core Competencies

MDI's team of scientists and engineers are innovative and responsive to our clients' requirements. Our core team is leveraged by relationships with a network of specialists enabling us to rapidly add capabilities needed to undertake new projects. The company structure enables us to be efficient and cost effective. MDI's team has critical experience and knowledge in extreme environment, non-equilibrium and non-contact materials processing. We add value for clients by providing "turnkey" solutions to their materials processing problems. Buying from MDI ensures success and reduces delays and risk. MDI provides access to:

### Experienced Staff...

Technical skills include 3D CAD design, x-ray and neutron data analysis and molecular dynamics simulations, LabVIEW programming, and experimental hardware design, testing and construction.

### Established Leadership...

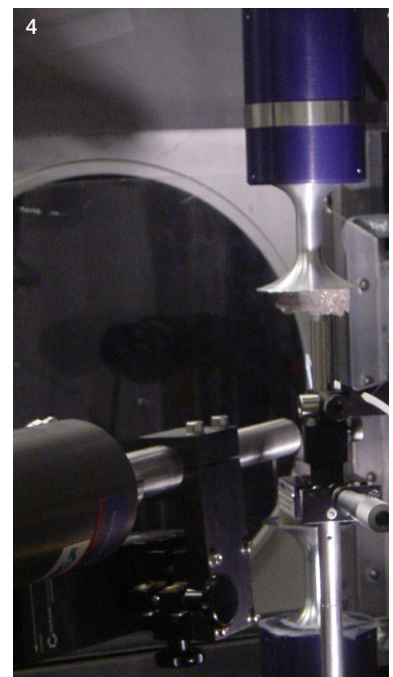
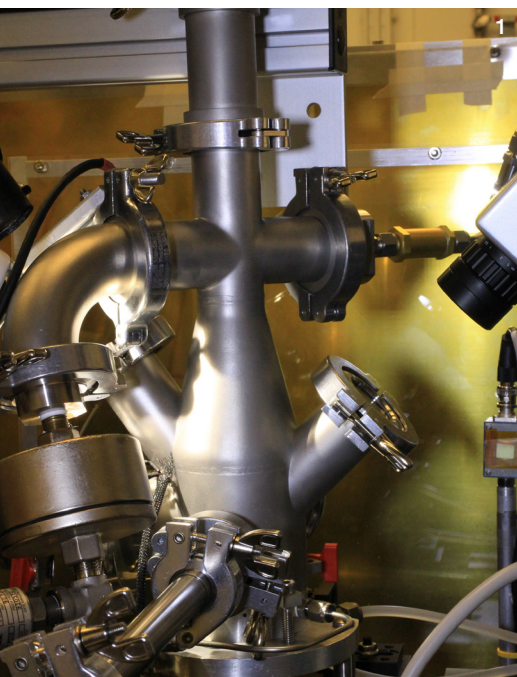
MDI research scientists publish highly cited, peer-reviewed work and perform pioneering materials research. They also participate in the research community and help to introduce young scientists to research through outreach.

### Intellectual Property...

Proprietary designs, methods and know-how, patents on instrument functionality and applications, and registered trademarks.

### Manufacturing Capabilities...

MDI's in-house capabilities include production and testing of our high power acoustic transducers and electronics and instrument assembly. These capabilities are leveraged by close relationships with precision 3D CAM machining and electronics design and software subcontractors.



**1.** A sealed environmental chamber used with the High Temperature Conical Nozzle Levitator (HT-CNL™). This arrangement can be used to contain samples (such as  $UO_2$ ) or to enable precise control of process chemistry by using controlled atmospheres such as  $CO/CO_2$ . It can be used to study glass formation and the effects of changing oxidation state of cations in molten materials. **2.** Images of two samples levitated in the HT-CNL. Left – molten zirconium oxide at ca. 3100 °C. Right – partially molten aluminum oxide – the lower part of the sample is polycrystalline. **3.** The heating laser, power supplies and control electronics used in an HT-CNL system at the NOMAD instrument at the Spallation Neutron Source, Oak Ridge National Laboratory. **4.** The Single-axis Acoustic Levitator (SAL™) installed at beamline 11 ID-C at the Advanced Photon Source, Argonne National Laboratory. The system is used to study processing of materials *in-situ*.

## Products, Services, and Technology Developments

MDI sells standard instrument products that are built against a purchase order. Custom development projects or development of materials can be performed under R&D and service contracts or proprietary agreements.

### Instruments for Innovation®

At MDI we develop and manufacture Instruments for Innovation®. Leveraging our proprietary designs and advanced technology developments, the instruments we produce enable non-contact (containerless) processing of materials at temperatures from about -40 to +3,500 °C. Our instruments are **easy to use and operate**, allowing a user to focus on their work rather than having to frequently “tweak” the instrument. MDI’s two standard instrument products are the Single-axis Acoustic Levitator (SAL™) and the High Temperature Conical Nozzle Levitator (HT-CNL™). MDI works with each customer to optimize the system installation to ensure that their specific objectives and requirements are met.

### Single-axis Acoustic Levitator (SAL™)

The SAL is an acoustic sample manipulator used to study liquids and low melting materials. Derived from a NASA-developed technology that was flown on the space shuttle, the instrument enables non-contact positioning and manipulation of solid and liquid products in the size range 0.5 to 3.5 mm and at temperatures from about -40 to +40 °C. The SAL can be operated on most horizontal surfaces and it can be integrated with laboratory instruments and/or beamlines to study materials *in-situ*.

### High Temperature Conical Nozzle Levitator (HT-CNL™)

The HT-CNL is used for non-contact extreme environment processing to study materials at high temperatures. The instrument can be used for work at temperatures up to about 3500 °C, with samples in the size range 0.5 to 3.5 mm diameter, and in a variety of chemically active or inert atmospheres. Having been perfected and ruggedized through R&D in the laboratory as well as testing in the demanding conditions of beamline research, the HT-CNL is ideally suited to the synthesis of novel glassy and amorphous phases, the high-purity processing of liquids at extreme temperatures, the investigation of supercooled and non-equilibrium melts, and accessing pristine liquid surfaces. Developed and supplied for laboratory use, the compact footprint of the levitator “head” allows the HT-CNL to be easily integrated with X-ray and neutron beamlines and other diagnostic instrumentation.

### Support Services

MDI assists customers to specify instrument requirements and installs equipment at customers’ facilities. Installation work can be basic set up, commissioning, and user training. For more complex projects, we can assist with project management and integration of systems with the customer’s infrastructure such as beamlines or other laboratory facilities. We can help to prepare planning documents and identify facility requirements such as utilities and laboratory workspace.

### Cutting-edge R&D

MDI staff perform independent, cutting-edge research to optimize our technologies and they collaborate with national laboratories and universities to investigate a variety of materials. This work includes both instrumentation and development of advanced applied glass products such as image plates and optical materials.

Much of the basic research is published through work with collaborators and scientists at institutions where our equipment is in use. In-house capabilities to investigate liquids and glasses made in extreme conditions are used to test instruments and to study synthesis of new materials. Our recent research includes synthesis of amorphous pharmaceuticals and investigation of liquid phase processing of multiferroic materials. Examples of some other application areas include:

- » Synthesis of novel and high purity inorganic and organic glasses.
- » Investigation of structural evolution in supercooled liquids during vitrification.
- » Uncontaminated processing of corrosive melts, e.g. molten  $\text{UO}_2$  around 3000 °C.
- » Investigation of amorphous pharmaceutical, food and cosmetic materials.

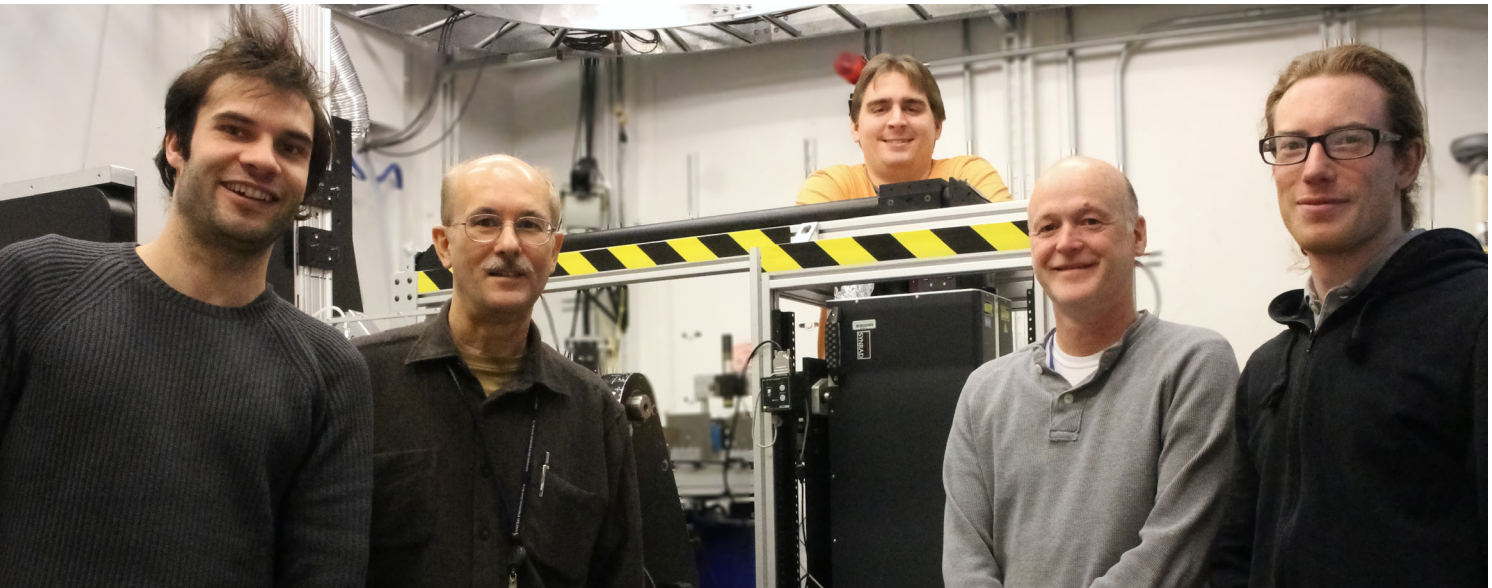
## About MDI

### Our History

MDI was incorporated in 2006 by Richard Weber. He successfully commercialized an optical glass technology while serving as Director of Research for Containerless Research, Inc., a company that he co-founded in 1993. MDI has an experienced technical staff and a seasoned business team. Our operations are based at the company's facilities in the Evanston Technology Innovation Center near Chicago.

### Our Team

The company has a team of technical staff and works closely with technical support organizations. The technical staff lead specific project areas and are responsible for making and implementing many of the technical decisions. The company holds regular meetings to review progress on projects, plans and general business to ensure the team is working together efficiently and producing high quality, on-time, on-budget deliverables. The work atmosphere is informal and goal-oriented. Business management and administration are handled by staff with experience in the requirements of technology development. The company is funded through commercial sales, government research contracts and owner investment.



▲ MDI's HT-CNL installed at beamline 11 ID-C at the Advanced Photon Source, Argonne National Laboratory. The system is being used to study molten uranium dioxide that is widely utilized as a fuel source. Left to right: Lawrie Skinner, Rick Weber, Anthony Tamalonis, Chris Benmore and Ollie Alderman.

### Our Customers

MDI serves customers by providing instrumentation and solutions to technical problems in materials processing and non-contact handling. Our market includes industrial and government laboratories and universities. MDI's customers are based in the North America, Europe, and Asia, and include:

- » Argonne National Laboratory, Argonne, IL
- » Coe College, Cedar Rapids, IA
- » Institut Laue-Langevin, Grenoble, FR
- » Oak Ridge National Laboratory, Oak Ridge, TN
- » Soleil Synchrotron, L'Orme des Merisiers, FR
- » SPring8, Hyogo, JP
- » Stony Brook University, Stony Brook, NY
- » University of Messina, Messina, IT

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