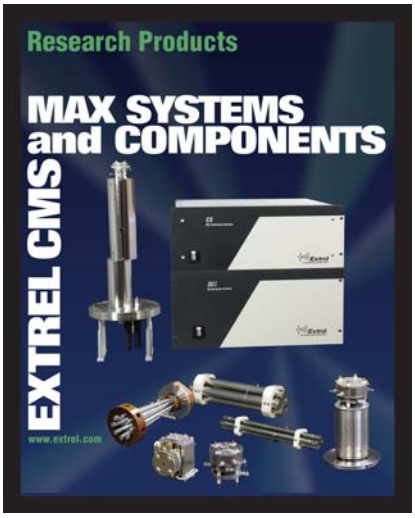
Nanocluster Selection and Transport

Components and Systems for Clusters Deposition and Spectroscopy

Extrel has been supplying quadrupole mass filters (QMF) as well as ion guides, deflectors and ion optics to the Clusters research community for more than 30 years. Our user base is widespread throughout university and government laboratories. Extrel is able to supply both individual components for a "building block" approach to system development and entire systems. Researchers rely on Extrel to provide the solution to their needs. With the trend in research funding favoring researchers who can provide a shorter period from funding, to system operation, to publication, researchers are relying more on Extrel's design consulting to provide complete systems designed to their specific requirements.



Clusters and Nanostructures can be generated from several different sources, such as Electro Spray Ionization (ESI), Laser Vaporization (LAVA), Magnetron Sputter. With these types of sources, ions are made at or near atmospheric pressure (0.3 torr to 760 torr). Clusters experimental systems are designed to transport and select clusters by size while removing neutrals.

Quadrupole mass filters serve a key role in clusters experiments; providing accurate size selection of clusters for use in downstream experiments. Extrel is well-known for high quality mass filters and RF power supplies used for cluster selection. In order to meet the expanding needs of the Nanoclusters research community, Extrel's product offerings have been expanded to include mass ranges as high as **16,000 amu** with resolution sufficient to separate single atom differences in clusters for atoms larger than 20 amu. In addition, Extrel's ion guides and ion optics, along with expertise in vacuum technology, can be applied to the solution of the ion transport and pressure reduction from any ion source. The production of size-selected clusters is used for two main applications, **Cluster Deposition** and **Spectroscopy of Clusters**.

In both cases, the initial needs are the same...	… and so are the solutions
• Sampling of ions from the cluster source • Taking ions off-axis to reduce neutrals • Ion transport and neutral removal • QMF for Cluster Selection	• Sampling apertures, optics, conical octupole • Quadrupole deflector and ion transfer optics • Ion guides with open design for pumping • Extrel Quadrupoles and RF supplies

Extrel CMS, LLC
575 Epsilon Drive, Pittsburgh, Pennsylvania 15238-2838 USA
Tel: (412) 963-7530 Fax: (412) 963-6578
Email: info@extrel.com www.extrel.com

Extrel Core Mass Spectrometers

Nanocluster Deposition System

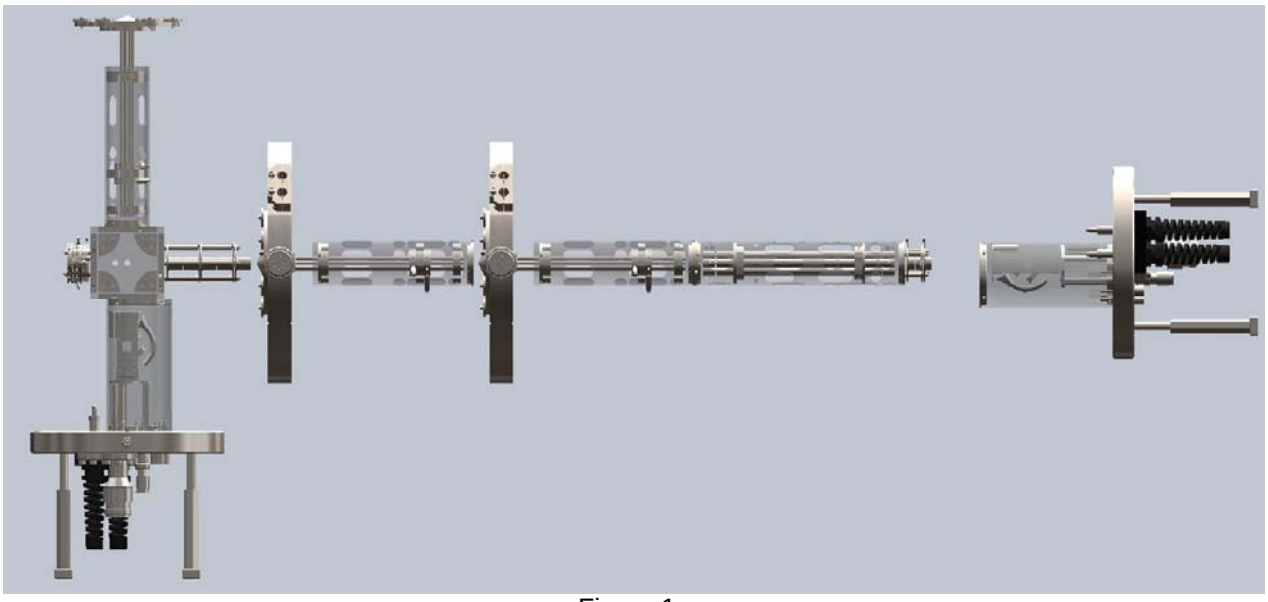


Figure 1

Figure 1 is one example of a system for Cluster Deposition that is designed for efficient ion transport and selection. Clusters from the source flow through the source aperture into the first pumping region where an octupole ion guide directs them to the Quadrupole Deflector (90-degree bender). The front of the octupole extends outside the housing to allow for maximum pumping to remove neutrals.

The ions are then taken around a 90-degree bend to further remove neutrals and allow the clusters to continue through an Einzel lens for focusing through the next aperture. An EI ionizer and a detector can be included in this stage for diagnostic purposes.

Larger diameter apertures and large pumps allow for maximum transport of ions. The number of pumping sections and pump sizes are selected based on the customer's particular requirements. In the example shown in Figure 1, the aperture is mounted on a radial flange with electrical connections for an octupole in this pumping stage.

The final aperture transitions to an octupole for further pumping and into a quadrupole mass filter for cluster selection. At the exit to the QMS, an Einzel lens focuses the clusters on the deposition target. A detector can also be included here for diagnostic purposes.

Extrel not only offers all of the components shown here, but can offer a system with pumps and chambers, drastically reducing the design and assembly time for customers. Pictured in Figure 2 is an example of a Clusters Deposition System provided by Extrel. This system includes a complete integrated control system within the system rack to maximize space utilization.

Figure 2

Extrel CMS, LLC

575 Epsilon Drive, Pittsburgh, Pennsylvania 15238-2838 USA

Tel: (412) 963-7530 Fax: (412) 963-6578

Email: info@extrel.com www.extrel.com

Extrel
Core Mass Spectrometers

Clusters Spectroscopy System

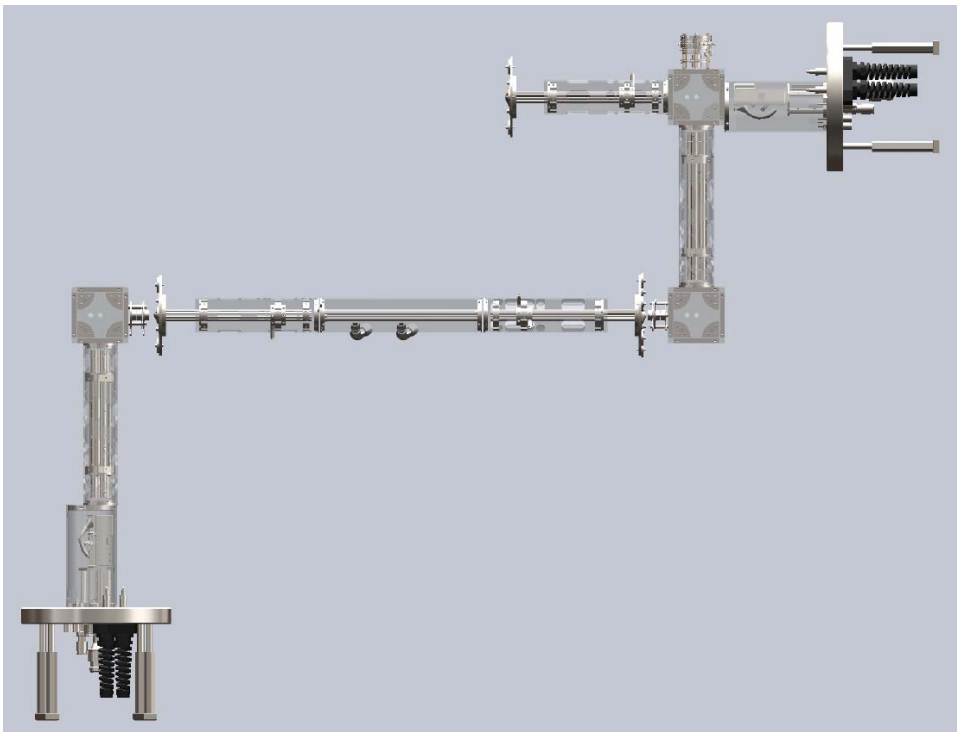


Figure 3

The system configuration shown in Figure 3 is designed for doing spectroscopy of clusters. The initial treatment of the clusters is the same as the deposition system, where ions are transported from the source through a pumping region and then taken off axis to remove neutrals.

Nanocluster System Components

- **Sampling Apertures**
- **Quadrupole Deflectors**
- **Einzel Lenses**
- **Multi-pole Ion Guides**
- **Gas Tight Housings**
- **Quadrupole Mass Filters**
- **Control Electronics**
- **Conical Octupole**
- **Hot/Cold Head**
- **Custom Designs**

After this the clusters are size selected by the QMF and then directed around another 90-degree bend to provide a clear path for the photon source.

Size selected clusters are then directed into the spectroscopy chamber where additional pumping further removes unwanted components. The spectroscopy section shown here includes a series of octupole ion guides, but systems could include any of a number of other devices such as a linear ion trap, a collision induced dissociation cell, or a cold trap.

Products from the photon interaction are directed through another aperture into the analysis chamber. Another Quadrupole Deflector, which maintains the clear photon path, directs the ions into the analytical quadrupole system.

As with the Clusters Deposition System, Extrel offers all of the components in Figure 3 as well as a complete system.

Extrel CMS, LLC
575 Epsilon Drive, Pittsburgh, Pennsylvania 15238-2838 USA
Tel: (412) 963-7530 Fax: (412) 963-6578
Email: info@extrel.com www.extrel.com

Extrel Core Mass Spectrometers

Design Consulting

These two systems are examples of Extrel's capabilities in designing systems for researchers who are interested in nanocluster experiments. There are many different components and options available to meet experimental needs. With the goal of generating data of primary importance, Extrel can offer complete systems including design consulting and a configuration uniquely intended for your experiment. Allowing Extrel to provide more of your system can reduce the time to produce data by months and even years compared to a do-it-yourself approach. Please contact Extrel to discuss your requirements.

Advantages of the Extrel Complete System Approach

- Design – Extrel has a great deal of experience integrating the required components and in many cases are modifying existing designs to meet the customers' individual needs. This experience can help eliminate trial and error approaches that cost more and take longer.
- Integration – Alignment, in-vacuum wiring, and system control are all complex issues when designing a Clusters experiment. An Extrel designed system will have most of these issues resolved.
- System Testing – To the extent possible, Extrel tests systems for basic operation.
- Training – Included with typical systems is installation by Extrel to make sure the system functions as it did in the factory, and provides basic overall system functionality for faster system operation.
- Time – All of this translates into time. In the research environment, funding depends on acquiring data and publishing results. Extrel's design team can help dramatically shorten the time it takes to get a system producing data. In one case, a customer's system they built themselves took 18 months to get operating, but the subsequent system Extrel delivered allowed them to be generating data in only 6 months.

Extrel CMS, LLC
575 Epsilon Drive, Pittsburgh, Pennsylvania 15238-2838 USA
Tel: (412) 963-7530 Fax: (412) 963-6578
Email: info@extrel.com www.extrel.com

Extrel
Core Mass Spectrometers