Proposed Sole Source Purchase Form

Pursuant to New Mexico Procurement law, the UNM Purchasing Department will post your completed form on the UNM Sunshine Portal for 30 days prior to purchase of the goods/services.

I. GENERAL INFORMATION. PLEASE PROVIDE THE FOLLOWING:

<table>
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<th>Date of Request</th>
<th>Requisition Number (If Applicable)</th>
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<td>12/20/2018</td>
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Request Submitted by: Abhaya Datye & Adrian Brearley

Title: Distinguished Professors

Department: Center for Micro-engineered Materials

Email: datye@unm.edu

Phone: 505-277-0477

Proposed Vendor: JEOL Inc

Amount: $2,468,412

Buyer Team - See Commodity list at [http://purchase.unm.edu/staff--commodities.html](http://purchase.unm.edu/staff--commodities.html)

Provide a basic description of goods/services to be provided:

Transmission electron microscope equipped with spherical aberration correctors to enable a finely focused probe scanning across the specimen, allowing images obtained in S/TEM mode. The microscope is equipped with dual, large-area, x-ray detectors for rapid acquisition of spatially resolved elemental composition maps.

Why is this purchase needed?

Research projects enabled by the instrument include studies of novel catalysts for exhaust emissions control and for energy storage, fuel cells using earth abundant metals, inorganic membranes that permit gas separation at elevated temperatures, nanoparticles for drug delivery, and interface defects in semiconductor materials used in solar cells and in optical communications. The microscope will also be used to study the environmental impact of toxic metals from mine wastes. The development of novel alloy compositions for nuclear reactors, improved cements to fortify deep underground exploration in oil wells, and ultra-conductive metal nanocarbon composites will also be enabled by this instrument.

II. BASIS FOR SOLE SOURCE PROCUREMENT. CHOOSE APPLICABLE BOX(ES) AND PROVIDE ADDITIONAL INFORMATION, AS REQUESTED:

☐ Proprietary item, technology or service only available from the proposed vendor. (Check box and describe proprietary component)

☐ Compatibility requirement with existing item, technology or service. (Check box and describe compatibility requirement)
☐ Renewal of support/maintenance/subscription of software, technology or other intellectual property. (Check box and describe)

X Other Basis for Sole Source: Please describe below:
The determination that the JEOL NeoARM is the only instrument meeting our research needs is based on the published specifications for each instrument and the evaluation of the performance of competing instruments by the principal investigators as described in the attached document. We visited installations where these microscopes have been installed and took our test samples and obtained images and EDS maps to study how well the instruments performed. What was important to us was the ease with which multiple samples could be studied, since this instrument will be located in a multiuser lab where the researchers will want to study multiple samples. The stability of the instrument, the ability to resolve single atoms and the ease of use are all important. We concluded that the instruments are comparable in terms of ease of use, but differ in their image resolution and energy resolution. We have determined that the JEOL NeoARM is the only instrument that meets our needs, which is why we are requesting a sole source determination, allowing us to purchase this instrument. Due to substantial discounts offered by the vendor, we are able to get the instrument at a price that we can afford, including two additional years of warranty service. With the JEOL instruments in our lab since 1985, we have had excellent service and each instrument has performed at the stated resolution throughout its lifetime. The installed sample holders will all be compatible with the new instrument, saving us the costs of buying new accessories.

III. SUPPLEMENTAL DETAILS. PLEASE PROVIDE ADDITIONAL INFORMATION AS REQUESTED BELOW:

Describe in detail the unique capabilities of the proposed vendor's goods/service and/or personnel performing the work and why this constitutes the only source. Focus on what is unique about the goods/service and why no other vendor could meet your needs.

The capabilities of the competing instruments were evaluated with a set of catalyst samples provided by Prof. Datye and meteorite samples provided by Prof. Brearley. The catalyst samples involved imaging of individual atoms of Pt on a ceria support. We compared images obtained from our evaluations in fall 2018 with images obtained previously (1) on the JEOL ARM 200 CF installed in 2011 at the Univ. of Illinois, Chicago. The images from the newest JEOL NeoARM were superior to those obtained previously on the ARM 200 CF at UIC (which is now 7 years old and the predecessor to the NeoARM). The JEOL NeoARM instrument also performed remarkably well in atomic resolution EDS mapping of meteorite samples. Based on our need to resolve isolated atoms in all of our projects, and for atomic resolution EDS mapping, we have selected the JEOL NeoARM as the only instrument that meets the needs of this NSF Major Research Instrumentation grant (NSF 1828731).

Describe the due diligence made to locate other possible sources including communications with other universities, communications with similar providers, web searches, yellow page searches, review of advertisements and trade publications, etc.

We initiated the project with numerous on site meetings with each of the vendors in Albuquerque to discuss specifications, plan visits to their installations, and the types of samples that we planned to investigate. In December 2017, the principal investigators submitted samples to the three vendors (Thermo Fisher, JEOL and Hitachi) who manufacture instruments that meet requirements for the research to be enabled by this grant. Prof. Brearley visited JEOL in Japan in Dec. 2017 and Thermo Fisher in January 2018. Images and analytical data (EDS maps) were provided by the vendors. Hitachi sent images via email. Some of these images were used in the grant application submitted to NSF in February 2018 where we stated that a more rigorous examination of the performance of these instruments would be conducted after the grant was awarded. Since August 2018, we have carried out further detailed evaluations by on-site visits where the instruments have been installed. The following visits have been concluded - Hitachi instrument (HF-5000) (Oct. 22-24, 2018, University of Arizona) Thermo Fisher Themis 200 (Nov. 1-2, 2018, University of Pittsburgh) and the NeoARM (Dec 2018). Based on these evaluations, we concluded that the JEOL NeoARM instrument is the only one which will meet the needs of our project.

List the other vendors who were contacted. Please describe the specs/qualifications/criteria that the other vendors were unable to satisfy.

Thermo Fisher, JEOL, and Hitachi were contacted as the three vendors who make instruments capable of meeting our research needs. The JEOL NeoARM provides the following capabilities that distinguish it from the other competing instruments: 1) TEM point to point resolution is 0.19 nm (UR pole piece) compared to 0.24 nm for the other two instruments. This demonstrates that the spherical aberration coefficient of the lenses is superior in the JEOL instrument which has impact on its performance and this difference is significant for the imaging performance of the instruments. 2) STEM resolution of 0.071 nm (UR pole piece) compared to 0.078 nm for the other two instruments. This is critical for imaging at the atomic scale allowing individual atoms to be detected with high contrast. 3) The JEOL and Hitachi instruments both have cold field emission guns with energy resolution of 0.3 eV, whereas the Thermo Fisher instrument uses a Schottky X-FEG gun with an energy resolution of 0.8 eV. The lower energy resolution is critical for high resolution electron spectroscopy without requiring an additional expensive monochromator ($1M). 4) The solid angle for EDS detection for the JEOL NeoARM (HR pole piece) is 0.98 x 2 steradians, which is comparable to the other two instruments. The combination of high resolution imaging and EDS analysis is critical for rapid acquisition of elemental maps at atomic resolution.