

Research Development Fund – Fall 2022 Application Template**Application Title: Upgrade of the Transmission Electron Microscopy in the Microscopy and Imaging Center (MIC)****Lead contact for RDF Application:****Name:** Kelvin Xie**Department:** Materials Science and Engineering**Email address:** kelvin_xie@tamu.edu**Phone number:** 979-458-3184**Key Participating Units:** Microscopy and Imaging Center: Larry Griffing, Avery McIntosh, Hansoo Kim, Rick Littleton, and Kelvin Xie with other current MIC PIs

RDF Amount Requested (\$): \$2,296,676.71

Executive Summary

This application is focused on improving our electron microscopy capability by purchasing a new ThermoFisher Talos F200i scanning-transmission electron microscope (S-TEM) to replace the current FEI Tecnai G2 F20 super-twin (ST) field-emission (FE) transmission electron microscope (TEM) for materials research in the Microscopy Imaging Center (MIC, located in the Interdisciplinary Life Sciences Building). The current FEI Tecnai was purchased as a used instrument and is over 19 years old, reaching the end of its service life. For example, the downtime of the Tecnai TEM was 80 days this past year and 114 days the previous year, which is 23% and 32% of the time. It is worth noting that the user fee of the Tecnai TEM went down from \$70 per hour to \$65 per hour during normal office hours since year 2020, despite its downtime and nationwide inflation. The decrement in the user fee is a direct result of the increase in demand for the instrument usage. With the anticipated longer downtime as the instrument gets even older, the state of the current instrument will act as a bottleneck for research teams at TAMU, who regularly use TEM to investigate structure at the nano-scale. Moreover, as the instrument ages, its performance deteriorates, including resolution, time to reach vacuum, and STEM alignment with respect to TEM. **Therefore, it is critical to upgrade the TEM now to maintain and enhance the research competitiveness at TAMU in the areas of materials, electronics, chemistry, agriculture, geoscience, and nuclear science and engineering.** Currently, MIC provides electron microscopy support to over 33 PIs and over 60 users, which is across 5 Colleges and 14 Departments as well as 2 industrial users as determined from the past two years. The new instrument, with its newer features and friendlier user-machine interface, is expected to further increase the user base and have a substantial positive impact on the material, biomedical, agriculture, and geoscience research at TAMU. To further enhance research capability and graduate education performed at MIC, we are requesting accessories (a carbon coater and a plasma cleaner) with two *in situ* TEM holders (one heating and one cooling). Combined with the current Hysitron PI-95 *in situ* straining holder and Protochips holder, the new additions will render MIC one of the strongest *in situ* imaging facilities in the nation.

The proposed tools will expand capabilities of the facility, enhance the availability of advanced imaging tools, enable training of students through formal graduate courses (e.g., MSEN 612: Fundamentals of TEM and MSEN 613: Advanced TEM) that employ these tools, and enable high resolution imaging on campus. The facility will support the research of 33 PI groups from MSEN, CHEM, MEEN, AERO, NUEN, BMEN, PHYS, ELEN, ISEN, CVEN, SCSC, PLPA, GEOL, OCEN, and MCMD in 5 different Colleges. Moreover, the new instrument will complement the training effort of the existing TITAN Themis-Z (S)TEM in the Materials Characterization Facility at TAMU. The new Talos (S)TEM is expected to help shorten the training period (current 8 full working days) on TITAN and promote TITAN's access to general users. Existing space in the MIC will be used so that no additional funds nor new space will be needed. The requested instrument and equipment will be integrated into the existing MIC core, where facility infrastructure is already in place as well as the expertise to ensure access and the maintenance of these tools. As advanced imaging resources are critical to many individual investigator grants. The upgrades described in this proposal will retain and enhance the competitiveness for new funding opportunities for interdisciplinary research, particularly from NSF, DOE, DOD, NASA, and industry.