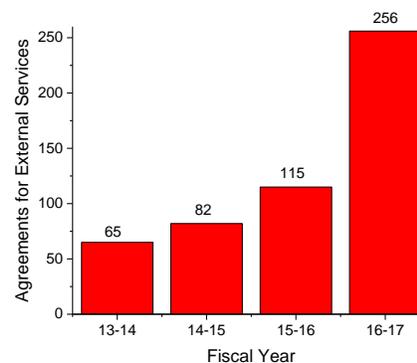


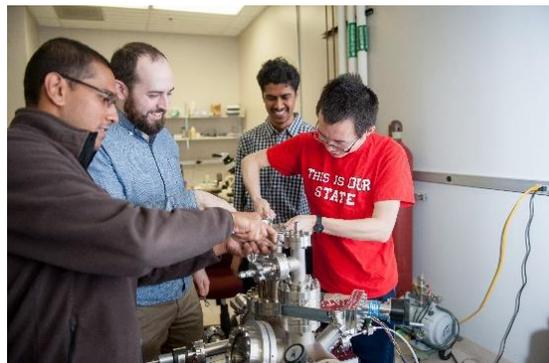
Mission and Capabilities: The AIF is NC State’s primary shared facility for materials characterization with a mission to enable and lead state-of-the-art research through acquisition, development, maintenance, training, and access to major analytical and materials characterization instrumentation. Through the support of engaged faculty and experienced staff, the AIF supports state-of-the-art scanning and transmission electron microscopes, X-ray scattering and spectroscopy instruments, mass spectrometry, scanning probe and Raman microscopy, nanoindentation, and extensive sample preparation facilities. Some of the extraordinary capabilities of these instruments include chemically-sensitive atomic-scale imaging, extreme-resolution SEM of insulating and soft materials, *in situ* high temperature and electric-field-dependent X-ray diffraction, cryogenic SEM of biological and soft materials, and *in situ* microscopy during heating, electrical current, immersion in fluids, and in flowing gases (to name a few). The AIF is positioned within the College of Engineering and is an NC State Core Facility.



Usage: In FY 17, the AIF was accessed by **156 NC State Principal Investigators** across campus and **484 users, who are mostly students and postdocs** (up from 424 users in FY 16, 369 in FY 15, and 379 in FY 14). These individuals come from the **Colleges of Agriculture and Life Sciences, Natural Resources, Engineering, Sciences, Textiles, and Veterinary Medicine**. In addition, the AIF supported materials characterization services for **127 external government, industrial, and other academic researchers** through managing **256 active contracts** (up from 115 contracts in FY 16, 82 in FY 15, and 65 in FY 14). Overall, the AIF provided **16,111 lab user hours** in FY17 (up from 11,330 in FY 14), representing a 3-year increase of >40%. Of all lab use hours, 25% were from external users.



Education and Engagement: The AIF is heavily involved in student training/education and engagement with the community. During FY 17, the AIF offered **35 training** workshops and short courses for hands-on training on topics including vacuum technology, SEM, TEM, XRD, surface analysis, and sample preparation. Many of the workshop topics were new and sought to train students in emerging areas of NC State interest, for example the XPS Data Analysis & Peak Fitting Short Course (10/16) and the Special Topics in TEM: EELS Workshop (3/17). The AIF also contributes to numerous NC State for-credit

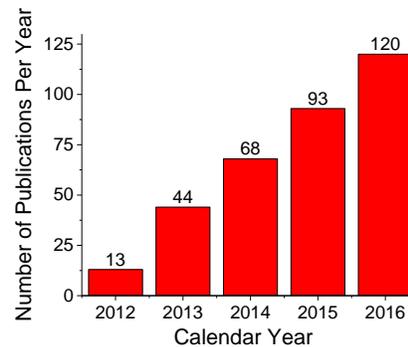


courses through laboratory demonstrations and hands-on exercises for both undergraduate and graduate students. In FY17, the AIF gave over **65 tours** for visitors, industry researchers, and classrooms. AIF engages with and enhances the missions of other research centers on campus, for example the Research Triangle Nanotechnology Network (RTNN), Center for Dielectrics and Piezoelectrics (CDP), and PowerAmerica, to provide short courses and workshops specialized for those constituencies, and proposal development to support such activities.

Progress on our Strategic Plan: The AIF has been executing a 4-goal strategic plan created in 2015 in consultation with faculty and staff. The entire plan consists of strategies, actions, and measures of success for each goal. The four goals include: (1) Enrich *on-campus research* by enhancing communication, graduate education and leveraging interdisciplinarity; (2) Strengthen relations with *external communities* to enhance the North Carolina workforce and economy; (3) Build the *next-generation infrastructure* that will enable new breakthrough research of tomorrow; (4) Enhance *operational and organizational excellence*. In FY17, we created and announced our new [Corporate Affiliates Program](#), which seeks to strengthen relations with external communities and the workforce. We developed better ways of *communicating with our customers and stakeholders* through email, newsletters, and social media and created a new “Cool Science” seminar series to [kick off in August of 2017](#). Finally, we helped to create a new *Lab Management system* through the Mendix platform in collaboration with the Office of Information Technology (OIT) and Office of Research, Innovation and Economic Development (ORIED) to manage all aspects of our shared facility’s business. The new system was released in July of 2017 and represents a significant increase in efficiency for our users and our organization as we strive for operational and organizational excellence. In the new system, training, reservation calendars, logging, and billing are all interlinked; and all approvals and processing is done electronically and integrated within NC State’s business systems. The new system is available [here](#) and support and FAQ located [here](#). AIF credits much of this success to the involvement of folks across campus and the hard work and persistence of Jack Foster in OIT.

New Instrumentation and Upgrades: The AIF is constantly acquiring new instruments and developing new capabilities. In the past year, for example, we commissioned a new *confocal Raman microscope* and a new *Atomic Force Microscope (AFM)*, both which were acquired through cooperation with ORIED. We also relocated a new Dektak 150 *surface profilometer* into our facility from the group of Prof. Jon-Paul Maria (MSE), providing state-of-the-art profilometry. Several instrument upgrades include two additional detectors in the dual-beam FIB/FESEM Quanta: a *retractable annular STEM detector* enabling scanning transmission imaging in bright field, dark field and high-angle dark field modes, and a *retractable directional backscatter detector* comprised of four concentric ring segments that enable separate detection of electrons backscattered to various angles. The new detectors can be used to rapidly screen FIB-prepared TEM samples and collect topographical and material (atomic number sensitivity) contrast images. A *Dual EELS system* was added to the Titan, we are now able to simultaneously acquire both the low-loss and core-loss spectra, e.g. enabling quantification of changing oxidation state across the sample. A new *X-ray monochromator* was added to the Rigaku diffractometer for high-resolution diffraction patterns, made possible through the efforts of Prof. Divine Kumah (Physics). *Uninterruptible Power Supplies* were added to the Quanta and Verios instruments to allow for graceful shut-downs in the event of power grid interruptions and outages.

Outputs and Impact: The AIF was authorized to work on **253 unique 5-account projects** in FY17, representing an impact to over **\$32M in annual research activity** on campus (up from \$24M in FY16, \$21M in FY15, \$17.4M in FY14). Users of the AIF published over **120 peer-reviewed technical publications** (full list [here](#)) in the calendar year 2016 (up from 93 in 2015, 68 in 2014, and 44 in 2013). Many of these publications receive national attention through news media or recognition in scientific communities. For example, papers titled, “[Anticancer Platelet-Mimicking Nanovehicles](#)” and “[Transition from Battery to Pseudocapacitor Behavior via Structural Water in Tungsten Oxide](#)”, were highlighted in NC State press releases ([Anticancer](#) and [Pseudocapacitor](#)).

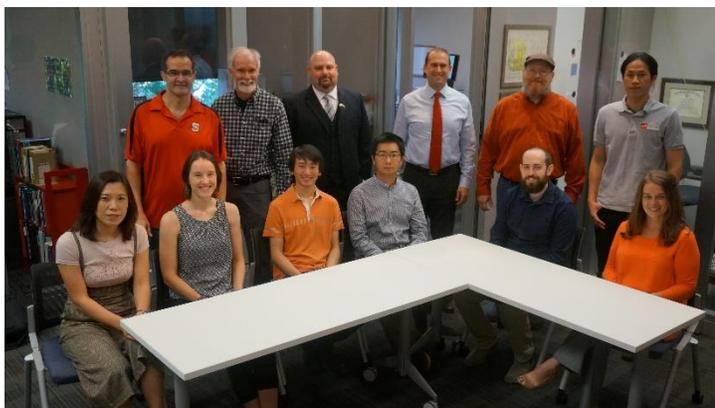


Graduate students and postdocs also win national awards based on their research conducted in the AIF; for example, NC State has won at least one Presidential Student award at the national Microscopy and Microanalysis

conference over the past four years. The AIF also internally awards two “Best Paper” awards every year. This past year, the two recipients were Yanqi Ye from the group of [Prof. Zhen Gu \(BME\)](#) for a [publication in *Advanced Materials* introducing a microneedle-based cell therapy](#) and Kelly Stano from the group of [Prof. Philip Bradford \(TECS\)](#) for [work published in *Small* on nanotube networks](#).

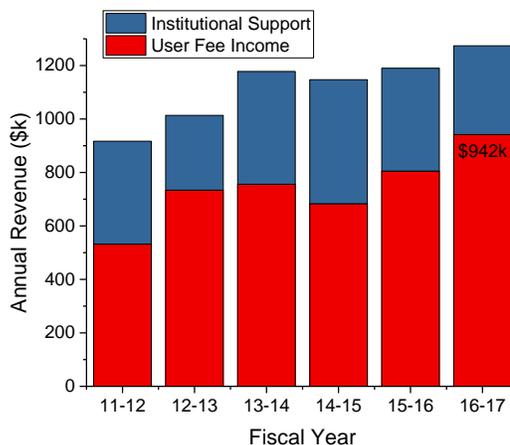
Assessment: This past year, AIF users were surveyed by an external evaluator (as part of the RTNN), allowing us to determine the level of satisfaction of AIF users with the facility. 99% of all existing users rated their experience as equivalent or better than their previous visit (n=71) and 100% of all users would come back again for future work (n=114). Overall facility satisfaction ratings were 6.26 out of 7.0 (SD=1.03) with similar satisfaction levels for staff and physical facilities. We acknowledge [Prof. David Berube](#) for the assessment.

Staffing: A total of 10 technical and business staff members (~8 FTEs) staff the facility with three tenured faculty members serving in director-level leadership roles and undergraduate students working as research assistants. The technical staff are experienced, collaborative, energetic, and student/training focused. Two business and administrative staff members were hired this past year, Shaun Diehl and Anna Ragsdale. Shaun came to NC State with a Masters degree in Higher Education Administration and Student Engagement from Penn State and with experience working at Duke and Penn State. Anna received her undergraduate degree in Psychology from NC State in 2013 and is excited to return to the Wolfpack after working outside the university in various administrative positions. Associate Professor Jim LeBeau from the Department of Materials Science and Engineering also joined AIF as an Associate Director, complementing the leadership team of Profs. Jacob Jones and Melissa Pasquinelli. Three undergraduate students who worked within AIF as research assistants have graduated, Mary Kasper (MSE), Athan Small (MSE), and Andrew Eicher (TECS). Two new undergraduate students are working in AIF in the summer of 2017, Maeve Sedivy (TECS) and Nicholas Rinz (TECS).



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Finances and Business: The AIF operates as a cost-recovery center, managing ~\$1.2M in annual expenditures across 22 different university accounts. The largest fraction of expenses are recovered from user fees (\$942k, or ~78%), with support also provided by the College of Engineering and the Office of Research, Innovation, and Economic Development (ORIED). **Support from the university is critical** to maintain a state-of-the-art facility, enable quality training of students and researchers, and offer competitive user rates for research activities. **Service contracts for the instruments** constitute a major portion of the annual expenditures (\$395,485 in FY17), and this number will grow as new instruments come online and the factory warranty periods of newly commissioned instruments terminate. Though large, this is a necessary expense to minimize downtime of instruments critical to the research enterprise and minimize the volatility of maintenance costs. As these expenses grow, we aim to grow facility usage concurrently (by both internal and external researchers) in order to maintain our competitive user rates.



Partnerships with the RTNN and the NNCI: The AIF is a member of the [Research Triangle Nanotechnology Network \(RTNN\)](#) and the [National Nanotechnology Coordinated Infrastructure \(NNCI\)](#). The vision of the RTNN is to be a national focal point for enabling innovative nanoscience and nanotechnology research, discovery, workforce development and education through: (1) open access to an evolving and integrated suite of cutting-edge fabrication and characterization facilities, (2) engagement of faculty and user populations with diverse research expertise to support the development of new processes, tools, and instrumentation, and (3) innovative training programs, outreach, and meetings/workshops to reach and educate new user populations.



Outlook: This is a very exciting time for the AIF and the research being performed within our facility. We aim to maintain this momentum by continuing to engage faculty and university leadership and continuing to satisfy our users. Successful growth of the facility will require continued acquisition of new equipment (in the past, this has mostly been enabled by the hard work of our faculty in writing external proposals and university leadership in allotting start-up packages of new faculty), and will also require overcoming some space and infrastructure challenges. Nevertheless, the AIF is known in the Research Triangle region of North Carolina as a leading materials characterization facility and has reached to new heights through our interactions with RTNN/NNCI. We are seizing opportunities to lead materials characterization nationally, and to significantly impact science and engineering research both locally and globally. Our AIF advisory board (formerly known as our faculty steering committees) will meet again in the Fall of 2017. If you are interested in joining or providing input to the AIF, please let us know. We welcome your input and engagement!

Visit us or contact us at:

<http://www.aif.ncsu.edu>

<http://www.rtnn.org>

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