

Center for Laser Applications

Executive summary

It is my pleasure to present the Annual Report for the Center for Laser Applications at the University of Tennessee Space Institute. CLA has undergone many changes in the last few years, and we are steadily moving towards the goals set by the UTSI revitalization plan while maintaining our excellence in the forefront of spectroscopy and laser materials modification. The revitalization plan included an emphasis on Materials Science and we have added two new faculty in this area. Jacqueline Johnson from Argonne National Laboratory joined us in November of last year and promptly secured a major grant from the National Institutes of Health for the development of materials for mammography. George Murray left Johns Hopkins Applied Research Laboratory in May to join CLA. George is an experienced researcher in molecular recognition and has made significant impact in the first few months on the UTSI team. The addition of new faculty, along with the hiring of post doctoral fellows and technical staff, prompted a fresh look at our strategic plan. The new strategic plan for CLA is presented following this summary.

As a graduate-only institution, we take great pleasure in awarding degrees to our students. This year five research assistants graduated; four with Master of Science degrees and one Ph.D. Currently we have 20 students enrolled at UTSI who are Graduate Research Assistants on CLA projects. In addition, we are proud of the accomplishments of our post doctoral fellows. Education of these young professionals is a significant part of our mission. This year two post doctoral fellow ended their tenure at CLA and obtained employment to continue to advance their careers. Additionally, the resources of the Tennessee Higher Education Commission allow us to employ summer interns. This summer we had one recent graduate of UT Martin, two undergraduate students, and three high school students. These interns help with the summer camp programs and engage in research for faculty investigators in CLA. Two of our mentored high school students won awards at Intel regional science fairs; William Yue won grand prize at the Chattanooga Regional Science and Engineering Fair and Ksenia Kuznetsova was a grand prize runner-up at the Middle Tennessee Science and Engineering Fair.

The output of our research program is evident in the increasing number of archival journal publications produced by the faculty and students. In Figure 1 the growth in CLA's publication statistics can be seen in a five year trend. This fiscal year 39 journal articles were published, many in high impact journals such as Optics Express and Journal of Applied Physics. This number will continue to increase as CLA has 21 other submissions in line for publication as of August 2008. In addition, CLA researchers made 44 presentations at conferences in the United States and abroad. Narendra Dahotre co-authored a book on laser

materials processing, and other faculty contributed chapters to four published books. These activities gain notoriety for the Center for Laser Applications and show the value of our research to the national scientific enterprise.

Our research expenditures are in line with past years. As shown in Figure 2, we are basically flat for the past three years which reflects our previous staffing levels. We expect the expenditures to rise with the addition of two new faculty, their students and staff. Research awards are healthy. Presently, externally funded research makes up approximately one-half of the operational budget for CLA. The Tennessee Higher Education Commission funds to the Center for Laser Applications are about one-fourth of our operational budget. Essentially, external research funds are 1.5 times the THEC center funding. Our goal is to drive this level to 2:1 in two years.

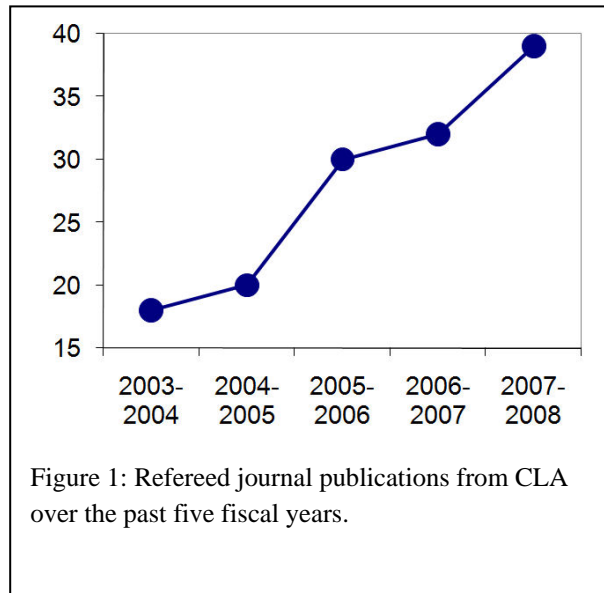


Figure 1: Refereed journal publications from CLA over the past five fiscal years.

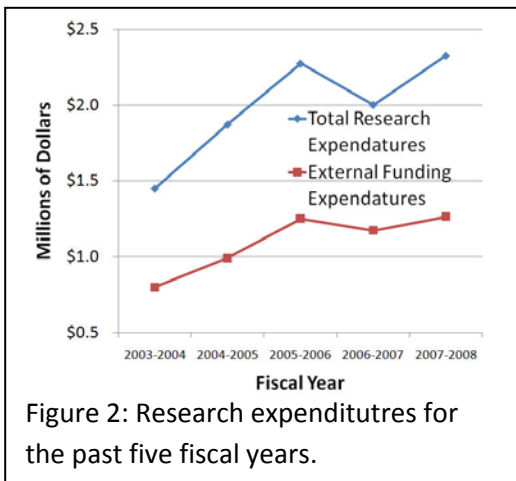


Figure 2: Research expenditures for the past five fiscal years.

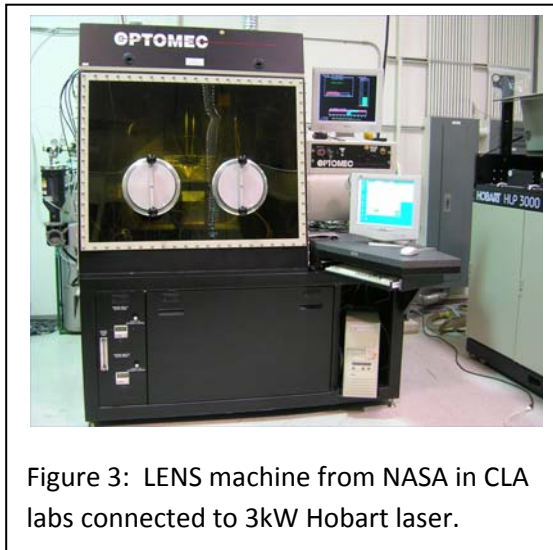
We are truly proud of our outreach activities at CLA. During the past three summers we have developed a vibrant summer camp program for local students and teachers. These programs emphasize peer learning and teaching, discovery and hands-on activities. For ASM Materials Camp the local high school students were asked to save the world from the global energy crisis. The students, assisted by post docs, graduate students, and summer interns learned about quantum

mechanics, band theory and applied these principles to solar energy collection. Students fabricated solar cells and measured their efficiency. In order to advance interest in science careers, the students put on a play entitled “A Quantum of Solars.” The play, written and directed by post doc Brian Canfield, illustrates and explains solar energy conversion. The



students performed the play at UTSI, videotaped the program, and posted it on You Tube. The Computational Science camp is equally innovative. Rising 7th and 8th graders are exposed to science through computer simulations. Bob Gotwals, our instructor, is a faculty member from the North Carolina School for Science and Math and an innovative educator. We involve our undergraduate interns and also sponsor three middle school teacher's involvement in this program.

The clean room and femtosecond nanomachining station, finished with last year's appropriations has been under heavy use this year and has resulted in several major publications and new innovations in non-linear optical modification of transparent materials and diamond films. We are currently well equipped for device fabrication in support of the single molecule spectroscopy initiatives. During this fiscal year we have completely revitalized the chemistry laboratory and set up processing facilities for Dr. Johnson's fluozirconate glasses. While no major equipment purchases were possible this year, we obtained two new major pieces of equipment. The Large Area Diamond Deposition System, able to process up to eight inch wafers was acquired from Vanderbilt University and is now operational in the CLA laboratories. In conjunction with direct metal deposition work with NASA Langley and Marshall Space Flight Center, NASA has loaned CLA an Optomec LENS machine (shown in Figure 3) to pursue high temperature materials freeform fabrication at UTSI.



We are enthusiastic about our opportunities for the future and proud of our past accomplishments. In the body of this report you will find brief synopses of our research projects. We appreciate your interest.

William Hofmeister

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Director, Center for Laser Applications