

## Femtosecond laser nanosurgery shedding light on nerve regeneration and treatment of cancer

by

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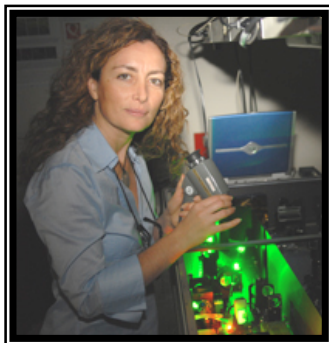
3:15 p.m. — Refreshments before the seminar

3:30 p.m. — Graduate Seminar

Room 1130 ME

**ABSTRACT** — The application of femtosecond (fs) lasers to biomedicine opens new opportunities for the study of biological systems and the diagnosis and treatment of diseases. The high peak intensities of fs-lasers enable nonlinear interactions between light and tissue. Nonlinear interactions confine energy absorption to focal volumes beneath the surface enabling selective ablation inside the tissue with high resolutions. This highly efficient and non-thermal ablation mechanism allows removal of tissue using low energy pulses, reducing both mechanical and thermal damage to the surrounding of the target. In this talk, I will first present our studies on laser nanosurgery performed *in-vivo* in the model organism, *C. elegans* [1]. By just cutting few nano-scale nerve connections (axons) inside *C. elegans*, we succeeded to remove the animal's ability to move backwards. The ability to perform precise nanosurgery on such organisms provides tremendous research potential for rapid screening of drugs and discovery of new biomolecules affecting regeneration and degeneration. Next, I will introduce a novel laser nanosurgery technique called plasmonic laser nanoablation (PLN) [2]. This technique takes advantage of surface-enhanced plasmonic scattering of fs-laser pulses in gold nanoparticles to vaporize tissue in atto-litter volumes. Finally, I will describe our recent efforts in the development of a multimodal “seek-and-treat” endoscopic system capable of delivering ultrashort laser pulses for microsurgery and nonlinear microscopy in a clinical setting for early diagnosis and treatment of cancer [3].

- [1] Yanik F, Cinar H, Cinar N, Chisholm A, Jin Y, and **Ben-Yakar A**, “Neurosurgery: Functional regeneration after laser axotomy.” *Nature* 432, 882 (2004). [pdf](#)
- [2] Eversole, D, Luk'yanchuk, B., and **Ben-Yakar A**, “Plasmonic Laser Nanoablation of Silicon by the Scattering of Ultrafast Pulses near Gold Nanospheres.” Invited paper, *Applied Physics A*, 89, 283–291 (2007). [pdf](#)
- [3] Hoy, C., Durr, N., Chen, P., Piyawattanametha, W., Ra, H., Solgaard, O., and **Ben-Yakar, A**, "Miniaturized Probe for Femtosecond Laser Microsurgery and Two-Photon Imaging", in review (2008).



### **Prof. Ben-Yakar Bio**

Adela Ben-Yakar is an Assistant Professor of Mechanical Engineering at the University of Texas at Austin. She obtained her Ph.D. in Mechanical Engineering from Stanford University in 2000. From 2000 to 2004, she was a postdoctoral researcher in Applied Physics at Stanford University and a visiting scholar at Harvard University. Her research interests are in femtosecond laser tissue interactions, fs-laser nano-surgery, plasmonic laser nano-surgery, two-photon imaging, and fs-laser applications for diagnosis and treatment of cancer and for *in-vivo* nerve regeneration studies.

Informal Faculty Luncheon: Wednesday, March 5, 2008, 12:00 noon. Meet in 1100 ME and walk to lunch with other faculty. Dr. Adela Ben-Yakar will be able to attend.