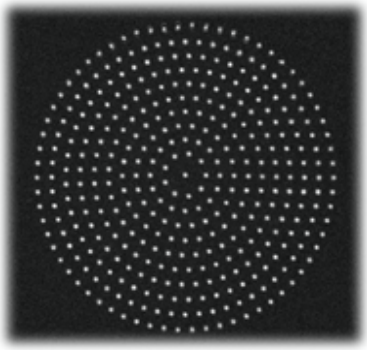
Eugenii U. Donev, Ph.D.



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RESEARCH INTERESTS

- LP-EBID, electron-beam-induced deposition of nanostructures from bulk *liquid* precursors.
- Plasmonic and thermal interactions of metal nanoparticles and films with scanning-probe tip under laser illumination.
- Optical properties of hybrid nanostructures combining plasmonic behavior of noble metals with solid-solid transformations of transition-metal oxides.

EDUCATION

Ph.D. in Physics, Vanderbilt University (Nashville, TN), Aug. 2003 – Dec. 2008:

- Dissertation: "Metal-Semiconductor Transitions in Nanoscale Vanadium Dioxide – Thin Films, Subwavelength Holes, and Nanoparticles"
- Advisors: Leonard C. Feldman & Richard F. Haglund, Jr.

M.Sc. in Physics, Vanderbilt University, Aug. 2003 – May 2006.

B.Sc. in Physics & German, *magna cum laude*, Sewanee: The University of the South (Sewanee, TN), Aug. 1999 – May 2003.

PROFESSIONAL EXPERIENCE

Summary:

- **Postdoctoral scholar:** *Hastings Research Group* (J. Todd Hastings), Dept of Electrical & Computer Engineering and Center for Nanoscale Science and Engineering (CeNSE), University of Kentucky (Lexington, KY), Nov. 2008 – present.

- **Graduate research assistant:** *Materials Physics Group* (L. C. Feldman) and *Applied Optical Physics Group* (R. F. Haglund, Jr.), Dept of Physics & Astronomy and Vanderbilt Institute of Nanoscale Science & Engineering (VINSE), Vanderbilt University, Summer 2004/8 – Fall 2007/8.

- **Graduate teaching assistant:** Dept of Physics & Astronomy, Vanderbilt University, Fall 2003/7 – Spring 2004/8.

Research accomplishments:

- Helped pioneer LP-EBID, novel direct-write technique for nanoscale deposition via electron-beam-induced decomposition of *liquid precursors* (LP), yielding nanostructures of much higher metal content (e.g., Pt and Au) than those deposited by gas-precursor EBID.

- Developed novel method for dynamical control of EOT ("extraordinary optical transmission") through arrays of nanoholes in noble metals using metal-semiconductor transition of vanadium dioxide (VO_2).

- Observed, using confocal Raman spectroscopy, for the first time the phase transition of *individual* VO_2 nanoparticles.

- Engineered hybrid Au+VO_2 nanoparticles (50–150 nm) exhibiting size-dependent surface-enhanced Raman scattering (SERS); created some of the smallest (~30 nm) lithographically patterned VO_2 nanoparticles.

- Explored modulation of plasmon resonance of VO_2-coated Au nanoparticles as a function of VO_2 phase (metallic/semiconducting), incident-light polarization, and particle size.

- Developed fabrication protocol for vanadium sesquioxide (V_2O_3) thin films, whose phase transition is very sensitive to small amounts of non-stoichiometry and impurities.

- Authored and reviewed manuscripts for journal publication; prepared parts of grant proposals.

- Taught four semesters of Introductory Physics Laboratory (40 students per semester).

Technical Skills

Laboratory tools & techniques:

- **Fabrication:** liquid-precursor electron-beam-induced deposition (LP-EBID), pulsed-laser deposition (PLD), thermal evaporation, plasma sputtering, spin coating, furnace oxidation/reduction and crystallization.

- **Patterning & Modification:** LP-EBID, electron-beam lithography (EBL), focused ion-beam (FIB) milling and lithography, scanning-probe-assisted laser nanopatterning, ion irradiation using 2-MeV Van de Graaff accelerator.

- **Characterization:** atomic-force microscopy (AFM), Rutherford backscattering spectrometry (RBS), X-ray diffraction (XRD), scanning electron microscopy (SEM), energy-dispersive spectroscopy (EDS), stylus profilometry, four-point-probe resistivity.

- **Optical:** attenuated total reflection (ATR), far-field transmission/reflection/spectroscopy, confocal microscopy, micro-Raman spectroscopy, scanning near-field optical microscopy (SNOM), ellipsometry, dark-field imaging.

Equipment designed & constructed:

- AFM-based optical setup for ATR excitation of surface plasmons and tip-assisted laser nanopatterning.

- Versatile optical setup for confocal transmission/reflection and dark-field scattering.

- Custom sample holders with thermoelectric/resistive heaters and thermocouples for optical measurements of VO_2 phase transition ($T_c \approx 340$ K).

- Compact cryogenic vacuum chamber with liquid-N_2 cold finger and external heating element for optical measurements of V_2O_3 phase transition ($T_c \approx 150$ K).

- Tube furnace system for thermal annealing in reactive atmosphere.

Computer software:

- **Calculations & Simulations:** Mathematica, Maple, COMSOL Multiphysics (plasmonics), Lumerical FDTD Solutions (plasmonics), SIMNRA (MeV ion scattering), SRIM/TRIM (transport of ions in matter), NIST DTSA-II (X-ray spectra), TrueBASIC (programming language).

- **Data acquisition & Analysis:** LabVIEW, MATLAB, IGOR Pro, Raith e_LiNE (e-beam lithography), Gwyddion (AFM images), Microsoft Excel.

- **Manuscripts & Presentations:** LaTeX, Microsoft Word & PowerPoint, EndNote, Adobe Illustrator.

- **Web design:** HTML, Adobe Dreamweaver, Flash & Photoshop.

OTHER EXPERIENCE

REU intern: *Laboratory for Electronic Materials & Devices*, University of North Texas (Denton, TX), Summer 2002. Designed and fabricated by UV photolithography prototypes of organic thin-film transistors on flexible plastic substrates.

Undergraduate projects: Dept of Physics & Astronomy, Sewanee: The University of the South, Spring 2002 & 2003:

- "Chaos in a Pendulum": Studied complex behavior of damped-and-driven pendulum through hands-on experiments and numerical simulations.

- "Spatio-Temporal Dynamics in Video Feedback": Demonstrated examples of stable, cyclical, and chaotic attractors, and implemented computational model of monochromatic video feedback.

AWARDS & HONORS

- 1st place in poster competition (38 contestants), *8th Annual Nanoscience & Nanotechnology Forum*, Vanderbilt University, 2007. Title: "Modulation of the Gold Particle-Plasmon by the Metal-Semiconductor Transition of Vanadium Dioxide".
- Dissertation Enhancement Grant, Vanderbilt University, 2006.
- 1st place in poster competition (43 contestants), *5th Annual Nanoscience & Nanotechnology Forum*, Vanderbilt University, 2004. Title: "Radiation Damage of CdSe Nanocrystals".
- William T. Allen Memorial Scholarship, Sewanee: The University of the South, 2003.
- Order of Gownsmen, Sewanee: The University of the South, 2000–2003. Honorary academic society.
- Full International Student Scholarship, Sewanee: The University of the South, 1999–2003.

PEER-REVIEWED PUBLICATIONS

- "Liquid-precursor electron-beam-induced deposition of Pt nanostructures: dose, proximity, resolution", **E. U. Donev** and J. T. Hastings, *Nanotechnology* 20, 505302 (2009).
- "Electron-Beam-Induced Deposition of Platinum from a Liquid Precursor", **E. U. Donev** and J. T. Hastings, *Nano Lett.* 9, 2715-2718 (2009).
- "Size effects in the structural phase transition of VO_2 nanoparticles studied by surface-enhanced Raman scattering", **E. U. Donev**, J. I. Ziegler, R. F. Haglund, Jr., and L. C. Feldman, *J. Opt. A: Pure Appl. Opt.* 11, 125002 (2009).
- "Confocal Raman Microscopy across the Metal-Insulator Transition of Single Vanadium Dioxide Nanoparticles", **E. U. Donev**, R. Lopez, L. C. Feldman, and R. F. Haglund, Jr., *Nano Lett.* 9, 702-706 (2009).
- "Using a Semiconductor-to-Metal Transition to Control Optical Transmission through Subwavelength Hole Arrays" (review article), **E. U. Donev**, J. Y. Suh, R. Lopez, L. C. Feldman, and R. F. Haglund, Jr., *Advances in OptoElectronics*, 739135 (2008).
- "Modulation of the gold particle-plasmon resonance by the metal-semiconductor transition of vanadium dioxide", J. Y. Suh, **E. U. Donev**, D. W. Ferrara, K. A. Tetz, L. C. Feldman, and R. F. Haglund, Jr., *J. Opt. A: Pure Appl. Opt.* 10, 055202 (2008).
  - Also selected for the journal's *Highlights of 2008* as one of "highest quality rating" research papers.

- "X-ray diffraction studies of the growth of vanadium dioxide nanoparticles", S. A. Pauli, R. Herger, and P. R. Willmott; **E. U. Donev**, J. Y. Suh, and R. F. Haglund, Jr., *J. Appl. Phys.* 102, 073527 (2007).

- "Effects of temperature and oxygen pressure on binary oxide growth using aperture-controlled combinatorial pulsed-laser deposition", N. D. Bassim, P. K. Schenck, **E. U. Donev**, E. J. Heilweil, E. Cockayne, M. L. Green, and L. C. Feldman, *Appl. Surf. Sci.* 254, 785-788 (2007).

- "Optical properties of subwavelength hole arrays in vanadium dioxide thin films", **E. U. Donev**, J. Y. Suh, F. Villegas, R. Lopez, R. F. Haglund, Jr., and L. C. Feldman, *Phys. Rev. B* 73, 201401(R) (2006).

  - Also selected for *Virtual Journal of Nanoscale Science & Technology*, vol. 13(22).

- "Modulated optical transmission of subwavelength hole arrays in metal-VO_2 films", J. Y. Suh, **E. U. Donev**, R. Lopez, L. C. Feldman, and R. F. Haglund, Jr., *Appl. Phys. Lett.* 88, 133115 (2006).

  - Also selected for *Virtual Journal of Nanoscale Science & Technology*, vol. 13(14).

REFERENCES

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