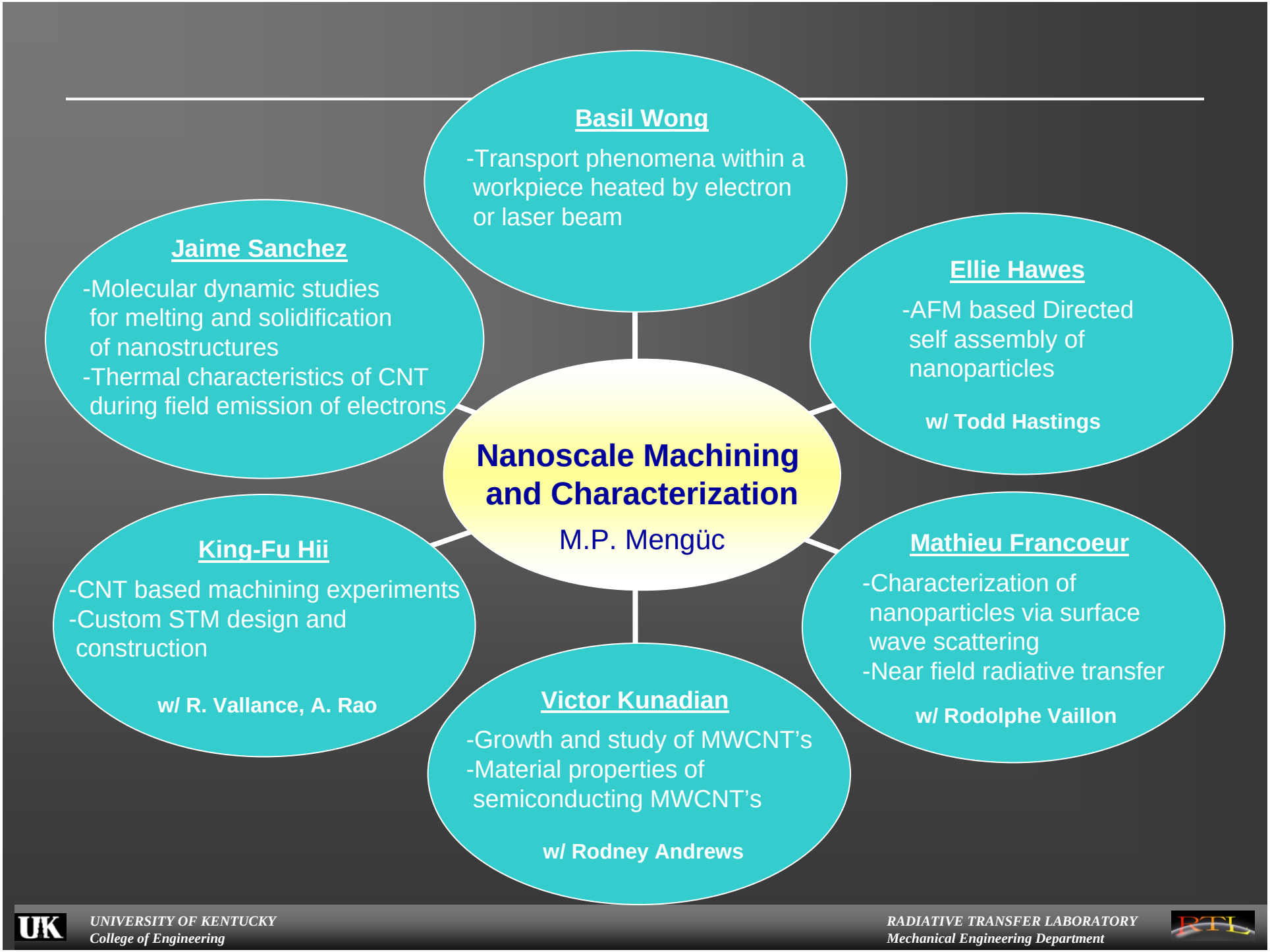
CHARACTERIZATION TO PATTERNING: ENGINEERING AT NANOSCALES

Research at the RTL

M. Pınar Mengüç

August 25, 2008


Basil Wong
-Transport phenomena within a workpiece heated by electron or laser beam
Jaime Sanchez
-Molecular dynamic studies for melting and solidification of nanostructures
-Thermal characteristics of CNT during field emission of electrons
Ellie Hawes
-AFM based Directed self assembly of nanoparticles
w/ Todd Hastings
Nanoscale Machining and Characterization
M.P. Mengüc
King-Fu Hii
-CNT based machining experiments
-Custom STM design and construction
w/ R. Vallance, A. Rao
Mathieu Francoeur
-Characterization of nanoparticles via surface wave scattering
-Near field radiative transfer
w/ Rodolphe Vaillon
Victor Kunadian
-Growth and study of MWCNT's
-Material properties of semiconducting MWCNT's
w/ Rodney Andrews

What do we do at RTL?

- Particle Characterization

  (Manickavasagam, Kozan, Francoeur, Aslan*, Swamy*, Vaillon)

- Surface-wave based Characterization of Nano-Particles

  (Francoeur, Venkata*, Aslan*)

- Surface-wave based Self Assembly of Nano-Particles

  (Hawes, Martin, Hastings)

- Near Field Radiation Transfer

  (Francoeur, Uddin, Vaillon)

- Field Emission-based Machining and Patterning

  (Wong, Sanchez, Hii, Kumar*, Albella*, Vallance, Rao)

PhD Student MS Student Research Associate
Faculty International Scholar Undergraduate Student *Past

COLLABORATORS: ACTIVE [recently graduated]

- **Research Associates:** Basil T. Wong, [Ellie Hawes, M. M. Aslan]
- **PhD Students:** Mathieu Francoeur ('09), S. Uddin ('10), King-Fu Hii ('08)
  Victor Kunadian ('08), Jaime Sanchez ('08)
  [M. Kozan ('07), E. Hawes ('07), JN Swamy ('07), B.T. Wong ('06)]
- **MS Students:** Brian Hawes [Pradeep Venkata, Ravi Kumar]
- **BS Students:** Robert Martin, Denis Livchak, B.J. Wellman, [Matt Robinson]
- **High School Students:** [R. Ray, Z. Katz, T. Liu, K. Kral]
- **External Ph.D. Students:** P. Albela (Spain), Guy Benoit (France), Kancy Lee (UCLA),
  Nazli Demiral (Turkey), Olivier Merchiers (Spain/France)
- **Industrial Collaborations:** S. Manickavasagam (STI), T. Yamaguchi (Horiba),
  B. Vaglieco (Istituto Motori, Napoli, Italy), M. Arik (GE)

COLLABORATORS: Professors

- **UK:** Todd Hastings, Vijay Singh, Bruce Hinds, Daniel Tao, Czarina Crofcheck, Fred Payne, Ingrid St.Omer, Jane Jensen, Steve Rankin, Zach Hilt, Zhi Chen, Rodney Andrews
- **Clemson:** A. Rao
- **GWU:** R.R. Vallance
- **UC San Diego:** Sungho Jin
- **Auburn:** D. Mackowski
- **Texas** J.R. Howell

- **France:** Rodolphe Vaillon, INSA, Lyon
- **Spain:** Fernando Moreno, Paco Gonzales (U. Cantabria, Santander)
- **Italy:** Bianca Maria Vaglieco (Istituto Motori, Napoli)
- **Turkey:** Tuba Okutucu (METU, Ankara)
- **Ecuador** Cecilia Paredes

Particle Characterization with Elliptically Polarized Light

Contributors:

S. Manickavasagam, M. Kozan, M. Francoeur, M. Aslan*, J.N. Swamy*, R. Vaillon, C. Crofcheck

PAPERS

Applied Optics, JQSRT,
Applied Spectoscopy,
Journal of Nanoparticle Research
1995-2008

Surface-wave based Characterization of Nano-Particles

Contributors to this research:

M. Francoeur, P. Venkata,
R. Charnigo, C. Srinivasan,
R. Vaillon, M. Kozan, M. Aslan

PAPERS

JQSRT, 2005-2007
ASME J. Heat Transfer 2007
JOSA-A, 2007

Near-field Radiation and AFM-Based Patterning

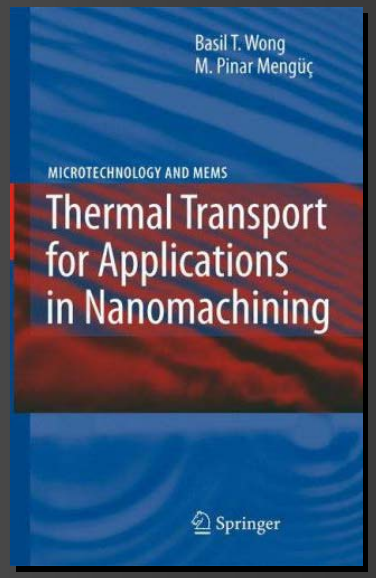
Contributors:

M. Francoeur, E. Hawes,
S.Uddin,
T. Hastings, R. Vaillon,
R. Martin

PAPERS

JQSRT, 2007, 2008
Optics Letters, 2008
Applied Physics Letters, 2008

Field Emission-based Machining and Patterning



Contributors:

Basil Wong, Jaime Sanchez,
Ravi Kumar,
Matt Robinson, King Fu Hii,
Tianming Liu
R. Vallance

PAPERS
Journal of Computational Nanosciences, 2006
Journal of Applied Physics, 2007
Physical Review B, 2007
Journal of Applied Physics, 2008
Nanotechnology, 2008
International J. Heat and Mass T., 2008
AIAA J. of Thermophysics and Heat T., 2008
J. App. Phys. D, 2008

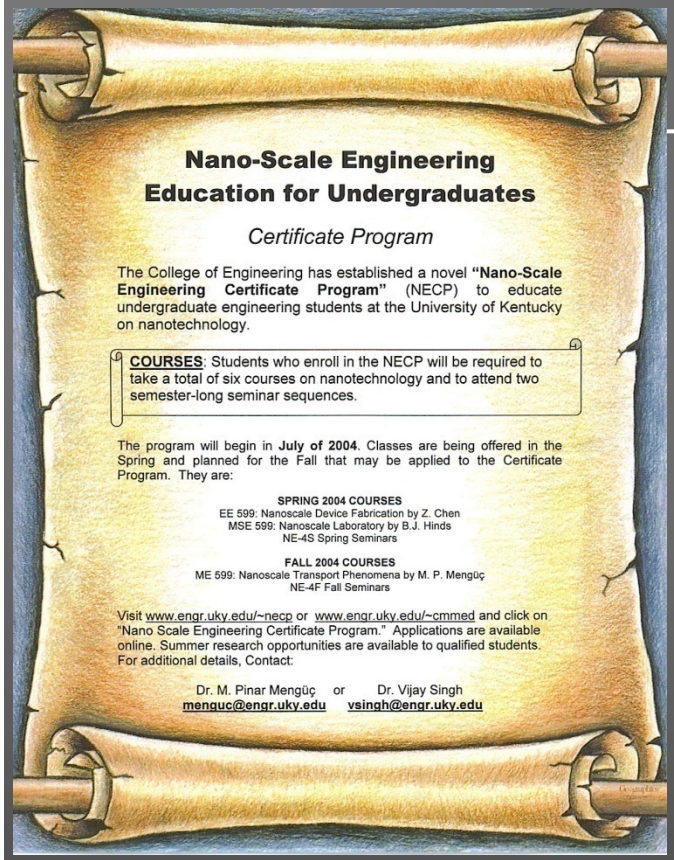
EDUCATION EFFORTS

Nanoscale Engineering Certificate Program

Honors Track on Nanotechnology

- Nanoscale Engineering Certificate Program

(Singh, Hastings, Hinds, Chen, Hilt, Vallance*, St. Omer)



Nano-Scale Engineering Education for Undergraduates

Certificate Program

The College of Engineering has established a novel **"Nano-Scale Engineering Certificate Program"** (NECP) to educate undergraduate engineering students at the University of Kentucky on nanotechnology.

COURSES: Students who enroll in the NECP will be required to take a total of six courses on nanotechnology and to attend two semester-long seminar sequences.

The program will begin in **July of 2004**. Classes are being offered in the Spring and planned for the Fall that may be applied to the Certificate Program. They are:

SPRING 2004 COURSES
EE 599: Nanoscale Device Fabrication by Z. Chen
MSE 599: Nanoscale Laboratory by B.J. Hinds
NE-4S Spring Seminars

FALL 2004 COURSES
ME 599: Nanoscale Transport Phenomena by M. P. Mengüç
NE-4F Fall Seminars

Visit www.engr.uky.edu/~necp or www.engr.uky.edu/~cmmed and click on "Nano Scale Engineering Certificate Program." Applications are available online. Summer research opportunities are available to qualified students. For additional details, Contact:

Dr. M. Pinar Mengüç or Dr. Vijay Singh
menguc@engr.uky.edu vsingh@engr.uky.edu

NANOSCALE ENGINEERING CERTIFICATE PROGRAM

NECP

EDUCATION

NE 1 Thermal Sciences at Nano-Scale *(Menguc)*

NE 2b Fabrication Fundamentals for Nanoelectronic Devices *(Chen)*

NE 2c Biomedical Micro- and Nanotechnology (*Hilt)*

NE 2d *NanoPhotonics (Hastings)*

Several other courses, Labs, Seminar Series

UMBRELLA PROGRAM ON NANOSCALE SCIENCES AND ENGINEERING

	HONORS/ ENGLISH	PHYSICS/ CHEMISTRY	BIOLOGY	ELECTRICAL / COMP ENGR	MECHANICAL ENGR	CHEMICAL / MATERIAL ENGR	OTHER DEPTS,
FRESH	Impact of Emerging Technologies: (Mengüç) Intro to Nanotechnology:(St. Omer)						
SOPH	The Other Side of the Nanotechnology Revolution (J. Jensen	SUMMER	SUMMER				
JUNIOR		SUMMER	SUMMER	MEMS/NEMS (St. Omer)			
SENIOR				Nanoscale Fundamentals of Nanoelectronic Devices (Singh) Fabrication of Nanoelectronic Devices (Chen) LAB-B: Integrated Circuit Device Fabrication (EXPERIMENTS) (St. Omer, Chen) Nano-Photonics (Hastings)	Nanoscale Transport Phenomena (Mengüç) Engineering Optics (Mengüç) Special Projects for Nano-Machining (Andrews/ Mengüç)	LAB-A1: Intro to Advanced Characterization (EXPER.) (Hinds) LAB-A2: Nanoscale Materials and Advanced Characterization (EXPER.) (Balk/Hinds) Biomedical Micro- and Nano-technology (Hilt)	By Special Invitation
				SEMINARS/GUEST LECTURES 1 and 2			

Honors Program Track on Nanotechnology

- *Scientific, Cultural and Social Impacts of Emerging Technologies: A Time Travel*
  (M. P. Mengüç)

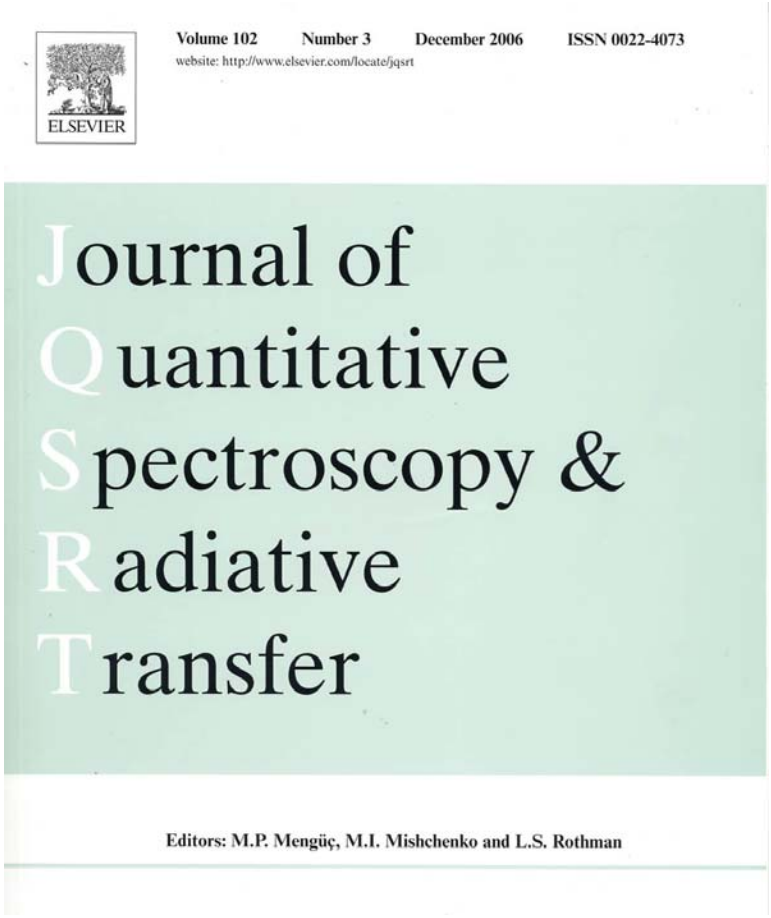
- *The Science & Art of Small: An Introduction to Nanotechnology*
  (Ingrid St.Omer)

- *The Other Side of the Nanotechnology Revolution*
  (Jane Jensen)

HON 121 (Fall 2005, 2006)
Scientific, Cultural and Social Impacts of Emerging Technologies: A Time Travel

- Roman Aqueducts and Early Civilizations
- Sea Farers and Ship Building during Renaissance
- Steam Engine and its Piracy
- Computers and Information Dissemination
- Nanotechnology.... A speculative approach

New JQSRT



ELSEVIER

New fully electronic submission and review system:
http://ees.elsevier.com/jqsrt/

New efficiency and new quality

New Editors:

- M. P. Mengüç, Radiative transfer
- M. I. Mishchenko, Electromagnetic scattering (single and multiple), active and passive remote sensing
- L. S. Rothman, Molecular spectroscopy (experimental and theoretical), spectroscopic remote sensing

For Questions please contact
M. Pinar Mengüç
menguc@engr.uky.edu

http://www.engr.uky.edu/~menguc/