Himanshu Tyagi

M.Sc-Ph.D dual degree in Physics
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Qualification	Year & Percentage/CPI	Institution
Research Associate	June 2016 - December 2016	Indian Institute of Technology Bombay
M.Sc. & Ph.D. dual degree in Physics	2008 - 2017 (CPI = 8.17)	Indian Institute of Technology Bombay
B.Sc. (Hons.) in Physics	2005-2008 (82.3%)	Hansraj College, Delhi University
Senior secondary PCM with Engineering drawing (12^{th} CBSE medium)	2005 (82.6%)	DAV Public School, Ghaziabad (U.P.)
Secondary (10^{th} ICSE medium)	2003 (83.17%)	Holy Angels School, Ghaziabad (U.P.)

Courses completed (M.Sc.):

Optical Properties of Nanostructured Materials, Advanced Simulation Techniques in Physics (using C++), Laboratory Techniques, M.Sc. Project (Stage-I, II, III), Quantum Electronics, Superconductivity and Low Temperature Physics, Light Matter Interactions, Electromagnetic Theory (I & II), Physics Lab (I, II, III), Statistical Physics, Introduction to Nuclear & Particle Physics, Introduction to Physics of Nanoparticles and Nanostructures, Methods in Analytical Techniques, Seminar (DNA nanoelectronics), Introduction to Atomic and Molecular Physics, Introduction to Condensed Matter Physics (I & II), Quantum Mechanics (I & II), Electronics Laboratory, Mathematical Physics (I & II), Programming Lab (Fortran 90), Electronics, Classical Mechanics, Communication and Presentation Skills.

Description of Research

Thesis title: **Gold Nanoparticles and Assemblies: Synthesis, Characterization and Tuning their Plasmonic Properties via Dielectric Oxides and Ions**
Ph.D. Supervisor: **Prof. M. Aslam,** Department of Physics, IIT Bombay

Research Highlights:

1) Synthesized spherical gold nanoparticles (diameter range: 2 nm to 100 nm) and nanorods (of various aspect ratios; size range 20 nm to 100 nm) under ambient conditions.
2) Explained formation of gold nanoparticles in a 'new pH-controlled and citrate-reduction based method' through analysis of reaction kinetics and via simulation of nucleation and growth process using MATLAB. (link)
3) Synthesized gold-silica based core-shells (diameter < 200 nm) and controlled their surface plasmon resonance using ion based approach and dielectric overcoats. Using similar approaches (in analogy with core-shell based studies), the plasmon resonance of gold nanoparticle based thin-films was also modulated successfully.
4) Devised and explained a new strategy to cloak nano-objects using plasmonic systems and demonstrated cloaking of plasmon resonance itself via an innovative approach based on cuprous oxide overcoat over core-shells. (link)
5) Investigated selective response of bare and small AuNPs towards silver and gold chloride ions and attributed it to interesting phenomena of anti-galvanic reactions over AuNP surface. (link)
6) As a part of collaborative research, contributed in investigations of ZnO nanowires (optoelectronic properties), iron oxide nanorods (modeling the magnetic field using COMSOL), CZTS solar cells (scattering from embedded silica NPs), layer double hydroxide & AuNP composite (explanation of near-IR heating) and filtration of nanoparticles using Graphene filter paper.

Publications

A) Publications in peer-reviewed journals:

1) **pH-dependent synthesis of stabilized gold nanoparticles using ascorbic acid**
Himanshu Tyagi, Ajay Kushwaha, Anshuman Kumar, and Mohammed Aslam
International Journal of Nanoscience 01/2011; 10, 857.
DOI: 10.1142/s0219581x11009301

2) **Tuning the Observability of Surface Plasmon in Silica−Gold Raspberry Shaped Nanoparticles Using Cuprous Oxide Shell**
Himanshu Tyagi, Jeotikanta Mohapatra, Ajay Kushwaha, and Mohammed Aslam
ACS Applied Materials and Interfaces 2013, 5, 12268−12274.
DOI: 10.1021/am4039079

3) **A facile pH controlled citrate based reduction method for gold nanoparticle synthesis at room temperature**
Himanshu Tyagi, Ajay Kushwaha, Anshuman Kumar, and Mohammed Aslam
Nanoscale Research Letters 2016, 11:362. DOI: 10.1186/s11671-016-1576-5

4) **The exclusive response of LSPR in uncapped gold nanoparticles towards silver ions and gold chloride ions**
Himanshu Tyagi, Tuhin Khan, Jeotikanta Mohapatra, Arijit Mitra, Hemen Kalita, Mohammed Aslam
RSC Advances 2016, 6, 109192-109200. DOI: 10.1039/c6ra23403h

5) **Role of defect states in magnetic and electrical properties of ZnO nanowires**
Ajay Kushwaha, **Himanshu Tyagi**, and Mohammed Aslam
AIP Advances 04/2013; 3, 042110. DOI: 10.1063/1.4801937

6) **Iron oxide nanorods as high-performance magnetic resonance imaging contrast agents**
Jeotikanta Mohapatra, Arijit Mitra, **Himanshu Tyagi**, D. Bahadur and Mohammed Aslam
Nanoscale, 2015, 7, 9174. DOI: 10.1039/c5nr00055f

7) **NIR Absorbing Au nanoparticles decorated Layered Double Hydroxide Nanohybrids for Photothermal Therapy and Fluorescence Imaging of Cancer Cells**
Eswaravara Komarala, **Himanshu Tyagi**, Shankar Thiyagarajan, Lina Pradhan, Mohammed Aslam and Dhirendra Bahadur
Journal of Material Chemistry B, 2017, 5, 3852-3861. DOI: 10.1039/C7TB00015D

8) **Surface-tailored graphene oxide paper: an efficient filter for dye pollutants**
Hemen Kalita, **Himanshu Tyagi**, and Mohammed Aslam
Environmental Science: Water Research & Technology, 2020, 6, 963-975.
DOI: 10.1039/C9EW01129C

B) Conference proceedings and related Presentations:

1) Presented a poster "**pH-dependent synthesis of stabilized gold nanoparticles using ascorbic acid**" in International Conference on Nano Science and Technology (ICONSAT) held at IIT Bombay in 2010.

2) **PVA stabilized gold nanoparticles using ascorbic acid as a reducing agent**
Himanshu Tyagi, Ajay Kushwaha, Anshuman Kumar, M. Aslam
AIP Conference Proceedings 01/2011; 1349, 419. DOI: 10.1063/1.3605913
Presented at 55th DAE Solid State Symposium-2010 (Manipal University).

3) **Magnetic core shell nanostructures with plasmonic properties**
Himanshu Tyagi, M. Aslam
AIP Conference Proceedings (2013); 1512, 324-325. DOI: 10.1063/1.4791042
Presented at 57th DAE Solid State Symposium-2012 (IIT Bombay).

4) **Efficiency enhancement in Cu2ZnSnS4 solar cells with silica nanoparticles embedded in absorber layer**
B. Ananthoju, S.M. Mopurisetty, **H. Tyagi**, D. Bahadur, N.V. Medhekar, S. Ganguly, M. Aslam
Photovoltaic Specialist Conference (PVSC), 2015 IEEE 42nd, 14-19 June 2015; 2015; pp 1-5. DOI: 10.1109/pvsc.2015.7355798

Experimental skills

Worked as expert operator as well as user on following systems:

- Transmission electron microscopy using **TEM** (Philips CM-200).
- Transmittance/reflectance/absorbance measurements using **UV-Vis-NIR spectrometer** (Perkin Elmer lambda 950).
- Scanning electron microscopy using **SEM** (Jeol JSM-6390).
- Electrical transport measurements using **probe station** and Keithley-26012A.
- Photoluminescence (**PL**) measurements using Varian Cary Eclipse fluorometer as well as home-made PL set-up employing an He-Cd laser as excitation source.
- **Thin film deposition** using Vacuum deposition unit (HindHiVac Model:12A4D).

Other systems used during research as a user:

Physical Properties Measurement System (PPMS), Fourier transform infrared spectroscopy (FTIR), X-ray photoelectron spectroscopy (XPS).

Computational skills

- *Code development:* **Mie calculations**, simulation of **Nucleation and Growth** of nanoparticles, calculation of **thin film reflection**/transmission.
- *Programming skills:* Fortran 90, C++, programming in **MATLAB**.
- *Softwares:* **COMSOL** (near-field simulations using RF module), **Lumerica**l (for simulation of optical spectra of nanoparticles), **ImageJ** (image analysis), Digital micrograph (TEM data analysis), **Cinema 4D (3-D modeling and animation)**.

- *Others:* Microsoft Office/Excel, OriginPro, Adobe Acrobat/Photoshop, comfortable in both Windows and Linux environment.

Teaching Experience

1) Teaching Assistant in Physics Laboratory (PH-117) for 1st year B.Tech. students at Dept. of Physics, IIT Bombay.
2) Teaching Assistant in '**Advanced Laboratory Techniques in Nanoscience** (EP-439)' Laboratory for 4th year Engineering Physics dual degree students of Dept. of Physics, IIT Bombay.
3) Guided one M.Sc. and five Engineering Physics dual degree students of Dept. of Physics, IIT Bombay for their course project.
4) Partial teaching assistantship for '**Nanomaterials, Nanostructures & Nanofabrication** (EP-412)' course for 4th year Engineering Physics dual degree students of Dept. of Physics, IIT Bombay.

Scholastic Achievements and Scholarships

1) Secured a rank of 219 in JAM-2008 entrance examination conducted by IITs.
2) Cleared Joint CSIR-UGC test for JRF-NET (2009) with a rank of 170 in Physical Sciences thus becoming eligible for JRF scholarship and lecturership.
3) Ministry of human resource development (MHRD) fellowship from Govt. of India (July 2008-July 2014) while pursuing M.Sc.-Ph.D. dual degree at IIT Bombay.
4) "Systopic scholarship" on basis of good academic performance awarded by Hansraj College in 2007-2008.

Other Activities

1) Research laboratory establishment and development
   - Setting up of **home-made Photoluminescence spectroscopy set-up**.
   - Setting up of **system for opto-electrical studies** of semiconducting thin films.
   - Setting up of Integration sphere and polarizer based accessories with conventional UV-Vis-NIR spectroscopy instrument.
2) Volunteer and participation in Techfest 2013 and Techfest 2014 (annual science and technology festival of IIT Bombay).
3) Volunteer and participation in 57th DAE SSPS, IIT Bombay, December 3-7, 2012.

Reference

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