

# Curriculum Vitae

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## Dr. Avesh Kumar

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## Qualifications

**2008-14 Ph.D. in Semiconductor nanomaterials, from School of Physical Sciences (SPS), Jawaharlal Nehru University (JNU), New Delhi-110067, India.**

**Thesis title:** Surface modification of semiconductor oxide thin films; study of electronic structure and effective photocatalytic activity of TiO<sub>2</sub> based nanocomposites.

**2003-05 M.Sc. in Physics with specialization in Electronics, from Dr. Bhim Rao Ambedkar University Agra, India, with a first class (70.58 %).**

**2000-03 B.Sc. in Physics, Chemistry and Mathematics, from Dr. Bhim Rao Ambedkar University Agra, India, with a first class (63.04 %).**

**1998-00 12<sup>th</sup> in General Hindi, English, Physics, Chemistry and Mathematics, from Board of High School and Intermediate Education Uttar Pradesh, India, with a first class (65.40 %).**

**1996-98 10<sup>th</sup> in Hindi, English, Science two, Mathematics two, Social Science and Biology from Board of High School and Intermediate Education Uttar Pradesh, India, with a first class (72.33 %).**

## Area of Research Interest

Synthesis of metal-oxide semiconductor nanoparticles and growth of semiconductor nanocomposite thin films, study of their structural, optical, electrical and morphological properties, measurement of work function, application of these nanocomposite thin films as photocatalyst for reduction of organic pollutants and water purification, study of swift heavy ion interaction with metal oxide thin films. Study of nonlinear optical properties of noble metal nanoparticles and semiconductor nanocomposite thin films, effect of interactions of laser beam with plasmonic nanoparticles.

## Experience

- 2021-Cont.** Currently; Assistant Professor (Guest faculty), in Maharaja Surajmal Brij University, Bhatratpur, Rajasthan.
- 2018-21** Post-Doctoral Fellow (PDF) under the scheme UGC-Dr. D. S. Kothari Postdoctoral Fellowship, Research Experience, in design development and control of plasmonic nanostructures for high performance applications from Dr. B R Ambedkar University, Agra, India.
- 2015-17** Post-Doctoral Fellowship (PDF), Research Experience, in nonlinear optical properties of nano-crystalline thin films, from Physical Research Laboratory (PRL), Navrangpura, Ahmedabad, India.
- 2018-21** Teaching M.Sc. Classes (Electronic properties and band theory, Rotational and vibrational spectroscopy, Statistical mechanics and Experimental techniques) with PDF from 02/02/2018 to 01/02/2021.
- 2017-18** Assistant Professor, Teaching Experience, from M. R. M. (PG) College, Bhadrauli, Agra.
- 2009-10** Teaching Assistance Experience, in School of Physical Sciences, Jawaharlal Nehru University, New Delhi, India.
- Synthesis of thin films of semiconductor nanostructures by e-beam evaporation, RF sputtering and spin coating technique.
  - Characterization by optical techniques by UV/Visible absorption spectroscopy,

FTIR spectroscopic techniques.

- Expertise in analyzing and operating scanning probe microscopic techniques like AFM and scanning Kelvin probe microscopic techniques.
- Structural characterization and analysis by TEM and XRD.
- Morphological study by SEM.
- Swift heavy irradiation studies on semiconductor nanocrystalline composite thin films.
- Initial part of my Ph.D. Thesis work involves synthesis of nanocrystalline  $\text{TiO}_2$  thin films and study of effect of swift heavy ion irradiation on surface and electronic properties of these films. A significant change in surface roughness and surface potential of  $\text{TiO}_2$  thin film was observed due to swift heavy ion irradiation. It is observed that the morphological and structural properties of ion beam irradiated thin films play an important role in shifting of Fermi level of these films. These changes can also contribute to creation of defects which in other words can modify the photocatalytic behavior of the nanocrystalline thin films.
- The next part of my thesis work focuses on study and enhancement of photocatalytic activity of  $\text{TiO}_2$  nanocomposite thin films.  $\text{TiO}_2$  nanoparticles act as photocatalyst by generating hydroxyl radicals which degrade the adsorbed dye molecules. The photocatalytic activity of  $\text{TiO}_2$  can be enhanced by modification of surface and by inhibiting electron hole recombination rate with doping of metals as well as non-metals. The absorption spectra of  $\text{TiO}_2$  can be extended into the visible light region by doping with nitrogen. This improves the photodegradation of organic pollutants in solar light irradiation. The study of work function as well as surface properties of thin films helps in better understanding of the photocatalytic activity of doped  $\text{TiO}_2$  nanocrystalline thin film. Advantages of photocatalytic treatment are that it does not transfer pollutants from one phase to another and it leads to complete decomposition of organic compounds.
- Effect of temperature on the photocatalytic activity and surface potential of  $\text{TiO}_2$  nanoparticles.
- Au- $\text{TiO}_2$  nanoparticles are expected to have better nonlinear optical properties and may find applications in optical switching, optical limiting and other optical devices. We synthesis Au- $\text{TiO}_2$  nanoparticles by sol-gel process and deposit on silicon

substrates to form nanocrystalline Au-TiO<sub>2</sub> thin films using spin coating method. These thin films were analyzed using different characterization techniques such as X-ray diffraction, UV-vis absorption etc. We measure the nonlinear refractive index and nonlinear absorption coefficient of the metal doped TiO<sub>2</sub> nanoparticles using the z-scan technique.

## Current Research Work

- Synthesis of metal oxide and noble metal doped oxide semiconductor nanoparticles with enhanced nonlinear optical properties. The nanocomposites are synthesized in the form of thin films on the substrates and characterized by different microscopic and spectroscopic techniques. They are expected to have better nonlinear optical properties than those in their independent states. When nanoparticles are excited near surface plasmon resonance wavelength, the local field inside the particle gets enhanced and causes enhancement in the nonlinearity.
- Interaction of different input laser beams with colloidal suspensions of plasmonic nanoparticles is studied. It results in different types of structures in the far field after propagation through a colloidal suspension.
- Optical limiting behavior of metal nanoparticles suspension is investigated. The light matter interactions can play important role in optical limiting mechanisms.

## Research Papers Published

1. Effect of laser beam propagation through the plasmonic nanoparticles.  
**Avesh Kumar**, Ajay Taneja, T. Mohanty, R. P. Singh.  
**Results in Optics**, **3**, 100081 (2021).
2. Transition from two-photon absorption to saturable absorption in gold patterned ruby thin film.  
Satchi Kumari, Shompa Kumari, **Avesh Kumar**, V. Kumar, and R. P. Singh  
**Optik**, **182**, 186 (2019).
3. Tunable optical nonlinearity of Au-TiO<sub>2</sub> nanocomposites.  
**Avesh Kumar**, R. P. Singh, T. Mohanty and A. Taneja.  
**Photon. Nanostruct. Fundam. Appl.** **33**, 1 (2019).

4. Electro-optic modulation induced enhancement in photocatalytic activity of N-doped TiO<sub>2</sub> thin films.  
**Avesh Kumar** and T. Mohanty  
**J. Phys. Chem. C** **118**, 7130 (2014).
5. Evolution of damage fraction due to dense ionizing irradiation on TiO<sub>2</sub> film.  
**Avesh Kumar**, D. Kanjilal and T. Mohanty  
**Appl. Sur. Sci.** **282**, 595 (2013).
6. Photo reduction altered work function of Au-TiO<sub>2</sub> nanoparticles measured by scanning Kelvin probe microscopy.  
Arun S. Patel, **Avesh Kumar** and T. Mohanty  
**J. Nanosci. Nanotechnol.** **13**, 8217 (2013).
7. Correlation of photodegradation efficiency with surface potential of silver-TiO<sub>2</sub> nanocomposite thin films.  
**Avesh Kumar**, Arun S. Patel and T. Mohanty  
**J. Phys. Chem. C** **116**, 20404 (2012).
8. Swift Heavy ion induced topography changes of Tin oxide thin films.  
Manoj K. Jaiswal, **Avesh Kumar**, D. Kanjilal and T. Mohanty  
**Appl. Sur. Sci.** **263**, 586 (2012).
9. Fermi level shifting of TiO<sub>2</sub> nanostructures during dense electronic excitation.  
**Avesh Kumar**, M. K. Jaiswal, D. Kanjilal, Rakesh K. Joshi and T. Mohanty  
**Appl. Phys. Lett.** **99**, 013109 (2011).

#### Conference Proceedings

1. Correlation studies of work function and optical nonlinearity.  
**Avesh Kumar**, S. G. Reddy and R. P. Singh  
**OSA Conference Proc.** **xxx**, xxx (2016).
2. Effects of annealed temperature on the properties of TiO<sub>2</sub> thin films.  
**Avesh Kumar**  
**AIP Conference Proc.** **1731**, 050064 (2016).

## Conference/Workshop/School

1. **Workshop:** workshop on instrumentation techniques in chemical analysis, **Department of Chemistry, Dayalbagh Education Institute, Dayalbagh, Agra**, November, 26-29, 2019.
2. **Poster Presentation:** Tunable efficiency of photocatalyst in water and environmental purification.  
18th international conference of the pacific basin consortium for environment and health (PBC), **Kyoto Kyoiku Bunka Center, Kyoto, Japan**, September, 16 -19, 2019.
3. **School attended:** School on quantum mechanics: Basic concepts and applications **Department of Physics, St. John's college, Agra, India** February, 16-17, 2019.
4. **Oral Presentation:** International conference on nano-structured materials and devices (ICNSMD-2018).  
**University of Delhi, Delhi, India**, December, 17-20, 2018.
5. **Attended:** 21<sup>st</sup> National Conference on Atomic and Molecular Physics (NCAMP), **Physical Research Laboratory (PRL), Ahmedabad, India**, January, 3-6, 2017.
6. **Poster Presentation:** Correlation studies of work function and optical nonlinearity.  
The international conference on fiber optics and photonics (PHOTONICS 2016), **Indian Institute of Technology (IIT), Kanpur, India**, December 4-8, 2016.
7. **Poster Presentation:** Studies of work function and nonlinear optical properties of Au-TiO<sub>2</sub> nanocomposites.  
International Conference on Technologically Advanced Materials (ICTAM) and Asian Meeting on Ferroelectricity (AMF10), **University of Delhi, New Delhi, India**, November 7-11, 2016.
8. **School attended:** Short term course on modern optical engineering, Department of Physics, **Indian Institute of Space Science and Technology (IIST)**, Valiamala, Thiruvananthapuram-695547, India, June, 26, 2016 to July, 2, 2016.
9. **Poster Presentation:** Effects of annealed temperature on the properties of TiO<sub>2</sub> thin films (*Conference proc. full length paper in American Institute of Physics*).  
60<sup>th</sup> DAE-Solid State Physics Symposium, **Amity University Noida, Uttar Pradesh, India**, December 21-25, 2015.

**10.Oral Presentation:** The electro-optic modulation induced changes in photocatalytic activity of TiO<sub>2</sub> thin films.

International conference on nanoscience and nanotechnology (ICNN-2013), School for Physical Sciences **Babasaheb Bhimrao Ambedkar University Lucknow-226025 (U.P.) India**, November 18-20, 2013.

**11.Oral Presentation:** Effect of shifting of Fermi level on photocatalytic activity of nitrogen doped TiO<sub>2</sub> thin films.

8<sup>th</sup> international conference on the environmental effects of nanoparticles and nanomaterials, **University of Marseille, Aix-en-Provence, France**, July 3 -5, 2013.

**12.Poster Presentation:** Correlation of photodegradation efficiency with surface potential of silver-TiO<sub>2</sub> nanocomposite thin films.

Nanoscience & condensed matter interface, **School of Physical Science Jawaharlal Nehru University New Delhi-110067, India**, March 7-8, 2013.

**13.Poster Presentation:** 100 MeV Ag ion irradiation induced surface potential changes in TiO<sub>2</sub> nanocrystalline thin films.

International conference on swift ions in materials engineering and characterization (SHIMEC 2012), **Inter University Accelerator Center, New Delhi -110067, India**, October 9-12, 2012.

**14.Poster Presentation:** Fermi level shifting of TiO<sub>2</sub> nanostructures during dense electronic excitation.

Presentation at national symposium on foundations and frontiers in supermolecular Chemistry, **School of Physical Sciences Jawaharlal Nehru University New Delhi - 110067, India**, March 1-2, 2012.

**15.Attended:** Work function and photocatalytic response of TiO<sub>2</sub> nanostructures.

National conference on recent advances in polymer nanocomposites (NCPN), **Zakir Husain College (University of Delhi) New Delhi, India**, January 14-15, 2011.

**16.Poster Presentation:** Effect of metallic dopant concentration on electrical & optical properties of nanocrystalline TiO<sub>2</sub> thin film.

International conference on nanoscience and technology, (ICONSAT) **IIT Bombay, India**, February 17-20, 2010.

## Awards & Honours

- A consistently good academic record with a first class throughout my academics.
- Selected for Council of Scientific & Industrial Research (CSIR), Senior Research Fellowship (SRF) in 2012, New Delhi, India.
- Selected for D. S. Kothari Post-Doctoral Fellowship (DSKPDF), in 2017-18, New Delhi, India.
- Travel Grant Awarded by Department of Science and Technology (DST), India for International conferences, **University of Marseille, Aix-en-Provence, France.**
- Grant Awarded by 18th international conference of the pacific basin consortium for environment and health (PBC) for present research work at **Kyoto Kyoiku Bunka Center, Kyoto, Japan**, September, 16 -19, 2019.

## References

1. **Name:** Dr. Tanuja Mohanty  
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2. **Name:** Prof. R. P. Singh  
**Designation:** Professor & Area Chairperson  
**Department:** Atomic Molecular & Optical Physics (AMOPH)  
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## IT Skills

A working knowledge of various application packages & multitude of IT solutions used in advance research & development in nanomaterials.

Operating Systems :Windows 7, XP

Documentation :Microsoft Office, Open Office

Computer Modeling :Origin

Experimental techniques :XRD, SEM, TEM, AFM, FTIR spectroscopy, Scanning Kelvin probe (SKP) force microscope, UV-Visible spectrophotometer and Z-scan technique.

## Personal Vitae

Home Town : Shikohabad, Uttar Pradesh, India

Date of Birth : November 28, 1982

Nationality : Indian

Religion : Hindu

Category : OBC

Marital Status : Unmarried

Languages Known : English, Hindi (Mother's Tongue)

Hobbies : Reading, Writing, Travelling, Listening Music, Watching Television.

## Declaration

I hereby declare that the information given above is mentioned true and correct to the best of my knowledge and belief.

**Place:** New Delhi, India

**Dated:** October, 2021

**Dr. Avesh Kumar**