# Archit Bahirat

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## EDUCATION

**Indian Institute of Technology Gandhinagar** *Gandhinagar, India*
B.Tech with Honours in Materials Engineering, CPI: 7.74 *2020-2024*

**M.P Junior College** *Pune, India*
HSC, Grade: 88.31 % *2018-2020*

## PUBLICATIONS & CONFERENCES

- Kumar, N†., Sharma, A†., **Bahirat, A.**, Joshi, G., & Khatua, S. (2023, June 6). Efficient Harvesting of >1000 nm Photons to Hydrogen via Plasmon-Driven Si–H Activation in Water. The Journal of Physical Chemistry C. https://doi.org/10.1021/acs.jpcc.3c01454. Our Research was featured on the cover of ACS Journal of Physical Chemistry C. Link: https://pubs.acs.org/toc/jpccck/127/28

- Naveen Kumar, Akanksha Sharma, **Archit Bahira**t, Gayatri Joshi, Saumyakanti Khatua, 'Efficient Harvesting of >1000 nm Photons to Hydrogen via Plasmon Driven Si−H Activation in Water', *VIII International Conference on Sustainable Energy and Environmental Challenges*, December 04-06 2023 in MNIT Jaipur.

- 'Enhancing Mechanical Properties of Polyurethane through $TiB_2$ nanosheets incorporation.'- Manuscript under preparation.

## INTERNSHIPS

**Summer Research Intern, University of Miami** *May2023-July 2023*

**Project Topic: Exploring the Photo-Thermal Effect: Investigation of Surface Temperature Changes in Gold Nanoprisms (AuTNPs) Exposed to different Laser Intensities** *; Advisor: Prof. Giacomo Po*

- Performed Finite Element Method (FEM) simulations using COMSOL Multiphysics software to investigate surface temperature variations of gold nanoprisms under different intensities: 88mW/cm^2, 100mW/cm^2 and 3700mW/cm^2.
- Applied a plasmonic heating model to predict and quantify the surface temperature changes in gold nanoprisms of varying dimensions.
- Executed detailed simulations and calculations to determine the temperature profiles of gold nanocubes, furthering insights into the relationship between nanoparticle shape and photo-thermal behavior.

## RESEARCH PROJECTS

**Multiscale Modeling and Experimental Validation of Photo-Thermal Effects in Plasmonic Photocatalysis**
*Advisor: Prof. Saumyakanti Khatua and Prof. Soumyadip Sett, IIT Gandhinagar* *Aug 2023-Present*

- Utilized the RF and Heat Transfer modules within COMSOL Multiphysics to simulate the intricate interplay between electromagnetic radiation, heat generation and heat transfer process.
- Predicted the wavelength dependent (532nm,635nm and 808nm) change in temperature of single nanoparticle with different geometries(nanorods, nanospheres, core-shell nanoparticle).
- Developed a heat transfer model for a photocatalytic experiment setup to predict the temperature change in the surroundings over time taking into account combined effect of nanoparticles on a plasmonic substrate.
- Simultaneously performing experiments to validate the simulation results for temperature rise using thermocouple, IR gun, thermometer etc.

**Investigation of Changes in Mechanical Properties of Polyurethane with TiB2 Nanosheets as Filler**
*Advisor: Prof. Kabeer Jasuja , IIT Gandhinagar* *Aug 2023-Present*

- Carried synthesis of Titanium boride nanosheets from bulk TiB2 using high energy ball-milling
- Added different percentages of nanomaterial into polyurethane to design novel composite with enhanced mechanical properties.
- Utilized methods such as UTM (Universal Testing Machine), DSC (Differential Scanning Calorimetry), and TGA (Thermogravimetric Analysis) for the comprehensive analysis of synthesized nanocomposites.
- The findings reveal significant enhancement in mechanical properties like UTS(Ultimate Tensile Strength) & Young's modulus of polyurethane maintaining its toughness. Currently, compiling these findings in a manuscript

**Tuning photocatalytic activity of Plasmonic nanoparticles through surface ligands**
*Advisor: Prof. Saumyakanti Khatua, IIT Gandhinagar* *Jan 2023-May 2023*

- Engaged in the synthesis of gold nanoprisms (AuTNPs) on glass substrate as photocatalyst.
- Attached various aromatic thiol ligands to the surface of AuTNPs and confirmed their presence by doing SERS(Surface Enhanced Raman Spectroscopy), enabling the investigation of their influence on photocatalytic performance.
- Designed and implemented dye degradation reactions, using both 532nm and 808nm lasers for photocatalytic studies.

**Effective utilization of NIR-II photons via plasmothermal Si-H activation**
*Advisor: Prof. Saumyakanti Khatua, IIT Gandhinagar* *May 2022-Jan 2023*

- Gained valuable hands-on experience in synthesizing gold triangular nanoprisms (AuTNPs) and gold nanospheres (AuNS) as highly efficient photocatalysts.
- Conducted rigorous experimentation to fine-tune the photocatalysis parameters, enabling the optimization of reaction kinetics and improving the selectivity and reactivity of the process.
- Carried out product extraction and characterized it using techniques like FTIR, NMR spectroscopy, LC-MS, HPLC etc.
- Successfully converted organic industry waste into valuable byproduct, demonstrating the feasibility of harnessing photocatalytic reactions for waste valorization. Due to novelty and excellent photon to hydrogen conversion, this work resulted in publication.

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## COURSE PROJECTS

**Thin film Deposition on Silicon Substrate**
*Advisor: Prof. Raghavan Ranganathan, IIT Gandhinagar* *Sep 2023-Nov 2023*

- Deposited silicon film on a silicon substrate using LAMMPS and studied the deposition as a function of deposition energy.
- Studied the effect of substrate temperature on film deposition and plotted pair-correlation functions.
- Analyzed the stresses developed during film deposition qualitatively and quantitively using OVITO.

**Deposition of AlN films on SLG substrate**
*Advisor: Prof. Emila Panda, IIT Gandhinagar* *Feb 2023-April 2023*

- Deposited Aluminum Nitride films of varying nitride concentration on glass substrate using RF-magnetron sputtering.
- Characterized the film using GIXRD, SEM imaging and UV-vis spectroscopy

**Synthesis and Recrystallization of Ni-20Co Alloys**
*Advisor: Prof. Pradipta Ghosh, IIT Gandhinagar* *Feb 2023-April 2023*

- Carried out synthesis of Ni-Co-20 alloy using electric arc melting, further samples were cold rolled at 50% and 80%
- Annealed the samples at different temperatures for about two hours and characterized using techniques like XRD, EDS and SEM.

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## TEACHING EXPERIENCE

**Academic Discussion Hours Mentor**

- Provided guidance and mentored to students enrolled in the 'Materials for Future Course' and 'Materials Thermodynamics and Kinetics' course at IIT Gandhinagar..
- Organized and conducted regular weekly doubt clarification sessions, creating an interactive platform for students to address challenging concepts and enhance their understanding.
- Offered patient and thorough explanations, helping students overcome difficulties and grasp key principles in the subjects.

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## SKILLS SUMMARY

**Instrumental Skills:** UV-Vis Spectrophotometer, FTIR, Gas Chromatography, Rotary Evaporator, Sonication, Centrifuge, ball milling, XRR, Spin-coating, Vacuum Oven, laser@ 532nm,808nm,635nm, Thermocouple
**Practical Skills:** Sample preparation for NMR spectroscopy, LC-MS, GC: shape and size selective Au nanoparticle synthesis( AuNS, AuTNPs,)
**Software Skills: :** COMSOL Multiphysics, LAMMPS, OVITO, ORIGIN, MS Office, Autodesk Fusion 360, ANSYS, MATLAB

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## RELEVANT COURSES

Material Characterization Techniques, Thin Film Processing and Characterization, Computational Process Design, Nanoscale Science, Physics of Materials, Material Thermodynamics and kinetics, Structure and Defects

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## POSITION OF RESPONSIBILITIES

**Event Coordinator Hallabol'23 , IIT Gandhinagar** *Feb 2023-March 2023*

- Assumed the responsibility of coordinating and ensuring the seamless execution of more than 13 diverse games during the intra-college sports fest 'Hallabol'.
- Orchestrated the logistical aspects and operational details for each game, guaranteeing their smooth progression and successful outcomes.

**Class Representative, Materials Engineering Discipline, IIT Gandhinagar** *Jan 2021-Sept 2022*

- Elected twice as the Class Representative for the Materials Engineering discipline, demonstrating trust and confidence from peers in leadership abilities.
- Assumed a pivotal role in ensuring the effective operation of all classes within the discipline, fostering a conducive learning environment

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## ACHIEVEMENTS AND AWARDS

- Received prestigious '**AMALTHEA**' Scholarship. Awarded with INR 1,50,000 (1815 USD) for being selected as Summer Intern at **University of Miami.**
- Cracked **JEE Advanced examination**, toughest engineering entrance exam in India and got admitted to one of the premier engineering college in India, IIT Gandhinagar.

## EXTRACURRICULAR ACTIVITIES

- Participated in Inter-College swimming competition and part of Institute aquatics team.
- **COVID Task Force Volunteering:** Contributed to implementing and overseeing COVID safety protocols for a secure campus environment.

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