

# ABDULLAH ARAFAT

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## EDUCATION

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### Master's, Mechanical Engineering

Aug 2022 - Jun 2024

University of Utah

GPA: 3.85

- Mathematics for Data Science, Molecular Simulation, Finite Element Method (FEM), Continuum Mechanics, Micromachining, Writing & Communication for Graduate Students.

### Bachelor's, Materials Science and Engineering

Feb 2017 - Mar 2022

Khulna University of Engineering and Technology (KUET)

GPA: 3.62

- Crystallography, Phase Diagram, Extractive Metallurgy, Corrosion and Surface Engineering, Materials Manufacturing Process, Computer-Aided Design, Welding and Metal Joining Process.

## RESEARCH PUBLICATIONS (Citations: 37) [Google Scholar link](#)

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### Book Section

- Mubin, Shafat, Jichen Li, and Steven Plimpton. Extending and Modifying LAMMPS Writing Your Own Source Code: A pragmatic guide to extending LAMMPS as per custom simulation requirements. Packt Publishing Ltd, 2021: Pages (304-306) - **Acknowledged contributor.**

### Journals

- **Arafat, Abdullah**, Md Islam, Naim Ferdous, A. S. M. Islam, Md Sarkar, Mosarof Hossain, Catherine Stampfl, and Jeongwon Park. "Atomistic reaction mechanism of CVD grown MoS<sub>2</sub> through MoO<sub>3</sub> and H<sub>2</sub>S precursors." Scientific Reports 12, no. 1 (2022): 1-12.
- Hossain Sarkar, Md Mosarof, Md Sherajul Islam, **Abdullah Arafat**, ASM Jannatul Islam, Naim Ferdous, Md Tawabur Rahman, Minhaz Uddin Sohag, Md Al Imran Fahim, Catherine Stampfl, and Jeongwon Park. "Effects of the Substrate Structure on the CVD Growth of Two-Dimensional Hexagonal Boron Nitride." The Journal of Physical Chemistry C 126, no. 14 (2022): 6373-6384.
- Komol, Md Mostafizur Rahman, Md Karimul Joarder, **Abdullah Arafat**, and Amit Kumer Podder. "Fingerprint and password controlled garage access system with belt pulley and power screw driven mechanism." International Journal of Advanced Mechatronic Systems 8, no. 1 (2020): 36-45.
- Komol, Md Mostafizur Rahman, Amit Kumer Podder, **Abdullah Arafat**, and Tanzim Nabeed. "Remote sensing global ranged door lock security system via mobile communication." International Journal of Wireless and Microwave Technologies 9, no. 5 (2019): 25-37.

### Conference

- Md. Jarir Hossain, Md. Mahbubur Rahman, Fahim Islam Anik, MD Ikramul Hasib, **Abdullah Arafat**. "Numerical Investigation on Fatigue Life Estimation of Aluminum Structure for Uniaxial Cyclic Loading by Finite Element Modeling." International Conference on Mechanical Engineering and Renewable Energy 2019 (ICMERE2019)

## RESEARCH EXPERIENCES

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### Master's Thesis: "Exploring nanoconfinement and structure-property relationships in the subsurface."

(Published in ProQuest Dissertations & Theses Global)

- Conducted molecular dynamics simulations to investigate transport properties of H<sub>2</sub>, CO<sub>2</sub>, and H<sub>2</sub>O in underground hydrogen storage (UHS) systems and the mechanical behavior of amorphous porous SiO<sub>2</sub>. Examined the effects of nanoconfinement on gas diffusivity and analyzed how pore morphology influences the elastic modulus and fracture behavior of SiO<sub>2</sub>.
- Key findings: Enhanced gas diffusivity in interlayer regions of UHS systems and a significant correlation between pore shape index and elastic modulus in amorphous porous SiO<sub>2</sub>

### Bachelor's Thesis: "Atomistic reaction mechanism of CVD-grown MoS<sub>2</sub> through MoO<sub>3</sub> and H<sub>2</sub>S precursors."

(Published in Scientific Reports, Nature)

- Performed reactive molecular dynamics simulations to study the reaction mechanism of MoS<sub>2</sub> synthesis via chemical vapor deposition (CVD) using MoO<sub>3</sub> and H<sub>2</sub>S precursors. Quantified the formation of intermediate molecules, surface composition changes, and sulfur detachment behavior during the early stages of CVD.
- Key findings: Identified a linear relationship between oxygen evolution and sulfur detachment above 1660 K and determined H<sub>2</sub>O to be the most stable byproduct during MoS<sub>2</sub> growth from H<sub>2</sub>S precursors.

## TEACHING EXPERIENCE

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### Head of Laboratory TA

Aug 2022 - May 2024

*University of Utah, Mechanics of Materials lab*

- Conducted laboratory sessions and supervised 200+ mechanical engineering students.
- Taught international standards: ASTM for experiment and safety protocols, ANSI, and ISO for engineering drafting.
- Set up and calibrated mechanical testing equipment: **Instron 5985** for dogbone specimen and rivet joint tensile tests, **Admet 9618 V** for torsion tests, **MTS Insight 50** for bending/column buckling tests, and **P3 strain indicator** for measuring strain in pressure vessels.
- Collaborated with instructors to develop new experiment procedures and co-authored the student lab manual.

## PROFESSIONAL EXPERIENCES

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### Mechanical Design Engineer

November 2018 - August 2022

*Emprotec Limited*

- Designed complex piping systems for applications such as LPG storage plants, autogas plants, satellite stations, and reticulation systems. Created detailed 2D/3D P&IDs, PFDs, and layout diagrams using SOLIDWORKS and AutoCAD Plant 3D.
- Conducted stress analysis and simulation of pipes using Finite Element Analysis (FEA) and managed accurate Bills of Materials for different processes.
- Performed on-site evaluations to assess current conditions and recommended design modifications.

### Operator

August 2019 - March 2020

*Fab Lab KUET*

- Maintained various equipment: **Ultimaker 3** for Fused deposition modeling (FDM) 3D Printing, **Roland MDX-540** for CNC milling, and **Epilog Laser MINI 18** for laser cutting.
- Drafted, Designed, and Manufactured 30+ projects by maintaining standards of Design for Manufacturing and Assembly (DFMA) and Geometric Dimensioning and Tolerancing (GD&T).

## PROJECTS

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### Investigated atomic and molecular hydrogen diffusion in SiO<sub>2</sub> using reactive molecular dynamics.

- Conducted a molecular dynamics simulation study on the diffusion of atomic and molecular hydrogen in silica crystals. For molecular hydrogen, the mean squared displacement (MSD) along the z-axis exhibited ballistic, caging, and diffusive regimes, with a calculated self-diffusivity of 0.3575 Å<sup>2</sup>/ps. In contrast, atomic hydrogen showed constant MSD, indicating confinement within the unit cell of SiO<sub>2</sub>, where hydrogen formed a bond with oxygen and remained localized near the oxygen atom throughout the simulation.

### Development of Python module for numerical analysis of aluminum alloy 6061-T6: elastic and plastic behavior.

- Developed a custom Python module for numerical analysis of the elastic and plastic behavior of aluminum alloy 6061-T6 using the dashpot spring model and the J2 elastoplastic model with both linear and swift hardening rules. The J2 model accurately predicted the onset of plastic deformation and strain-hardening behavior, with swift hardening demonstrating superior performance compared to linear hardening. Additionally, the dashpot spring model effectively modeled the alloy's plastic behavior under uniaxial tension,

### Enhancing mug warmer efficiency: FEA-driven thermal analysis and optimization.

- Performed a finite element simulation of a mug and mug warmer system using Fenics, an open-source finite element code. The simulation demonstrated that the mug warmer effectively maintains the liquid's optimal temperature over time without excessively heating the mug itself.

### Photolithography and micro-imaging on 4-inch silicon wafer

- Fabricated PDMS molds with microstructures using DRIE and NaOH wet etching techniques. Created silicon masters with high-aspect-ratio pillars and pyramidal textures, casting PDMS molds for microfabrication applications. Characterized the molds using profilometers and optical microscopy, achieving precise patterning with minor deviations in feature dimensions. Developed hands-on expertise in cleanroom processes and microstructure fabrication techniques.

### Microstructure analysis and mechanical property evaluation of steel: material selection & application.

- Performed metallographic techniques, including polishing and etching, were used to observe the steel's microstructure under a microscope. The mechanical properties, such as hardness and toughness, were tested using methods like tensile testing and hardness measurements.

## SKILLS

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- **CAD/CAM:** DFMA, SOLIDWORKS, AutoCAD, Fusion 360, Key Shot, Blender.
- **Simulations:** LAMMPS, VMD, Ovito, VESTA, Paraview, Materials Studio, ANSYS, Abaqus, Fenics, Comsol.
- **Microfabrication:** Clean Room (class 100), CVD, PVD, Lithography, Dry Etching, Wet Etching, Oxidation.
- **Hands-on skills:** Tensile/Compression test, Torsion test, Bending test, Column buckling test, 3D printing, CNC Milling, Laser cutting, Pressure vessel strain test, Welding, Rivet joint design, Brinell hardness test, Charpy impact test, Fatigue test, Molding, Sand casting, Pattern design.
- **Programming, Data Analysis & Others:** Python, C/C++, Matlab, Bash, Batch, Latex, ImageJ, Adobe Illustrator, Photoshop, Documentation, Outlook, Excel, Powerpoint.
- **Certifications:** Certified SOLIDWORKS Associate (CSWA), Certified SOLIDWORKS Professional (CSWP)
- **Soft skills:** Communication, Leadership, Problem-solving.

## AWARDS

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- ASME CUET Extrusion CAD Contest - 2nd/100 participants Aug 2020
- Dean List Award for academic excellence Jan 2019
- IPE FEST CAD Contest - 2nd/75 participants Dec 2018
- Ignition CAD Contest - 1st /150 participants Sept 2018
- WASH Innovation Challenge 2018 (Bhutan) - Finalist in South Asia Oct 2018
- 9th International Olympiad on Astronomy and Astrophysics (Indonesia):  
Finalist among 41 countries Jul 2015

## EXTRA-CURRICULAR EXPERIENCES

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- Dassault Systems community - Official SOLIDWORKS Champion 2021 - Present
- Graduate Student Advisory Committee (GSAC) - Member 2023 - 2024
- American Geophysical Union - Member 2023 -2024
- KUET Career Club - Head of IT and Resource 2019 - 2022
- CADers - Head of IT and Resource 2018 - 2020

## CERTIFICATIONS

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- Certified SOLIDWORKS Associate (CSWA)  
Score: 240/240 | Organization: Dassault Systèmes | Credential ID: C-49FPLUKRNS
- Certified SOLIDWORKS Professional (CSWP)  
Score: 318/318 | Organization: Dassault Systèmes | Credential ID: C-A6HWVU5MSB

## ONLINE COURSES

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- **Materials Data Sciences and Informatics** | Platform: Coursera (Georgia Institute of Technology) | Duration: 1 month. (August 2019) | Grade: 91.1% | Credential ID: 4NJG5524REYV
- **Python for Data Science and AI** | Platform: Coursera (IBM) | Duration: 1 month. (February 2020) | Grade: 98% | Credential ID: MBAN9P4DZGBD
- **From Atoms to Materials: Predictive Theory and Simulations** | Platform: edx (PurdueX)
- **Design and Simulation courses:** Design for Machining, Design for Additive Manufacturing, Abaqus Heat Transfer, Abaqus Stress Analysis, Abaqus Thermal Stress and Deformation, SOLIDWORKS Efficient Modeling and Design Intent, SOLIDWORKS Mold Tools and Plastic Design | Platform: SOLID professor | Duration: 2-3 months