University of Nevada, Reno

Semiconductors and Nanofabrication at UNR

Russ Renzas, Ph.D.

Research Faculty, Electrical Engineering

Director, Davidson Foundation Cleanroom

University of Nevada, Reno

2026

Lab Director

Russ Renzas, Ph.D. (UNR since Jan. 2024)

- Ph.D. Chemistry, UC Berkeley (2010), BS EE Princeton (2005)
- Created Rigetti Quantum Computing Fab-1 (company now on NASDAQ)
- Oxford Instruments Plasma Technology Quantum Technology Market Manager (dramatically increased ALE product adoption)
- 20+ peer reviewed academic publications, 4000+ citations, 3 patents

- Transform Northern Nevada's economy through nanofabrication research and education/training
- Enable the next generation of solid state devices through innovative chemistry and materials science

Davidson Foundation Cleanroom: Grand Opening (April 2025)

University of Nevada welcomes a new nanofabrication lab to campus

The University of Nevada, Reno College of Engineering is celebrating the grand opening of a new industry and nanofabrication lab on campus.

Reno-Area Semiconductor Companies Today (subset)

HORIBA

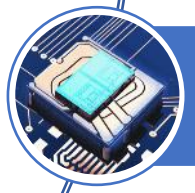
- R&D for Mass flow controllers used in Tier 1 semiconductor tools

Asia Union Electronic Chemicals Corporation

- Ultrapure chemicals for Tier 1 semiconductor manufacturing

Micromanipulator

- Probe Stations (semiautomatic, 300 mm)



Atlas Magnetics

- Ultra-efficient power convertors with layered inductors

Inneos

- Photonic Devices: Vertical Cavity Surface Emitting Lasers

ANATECH USA PLASMA TECHNOLOGY
Hummer Sputtering Tools — Innovative Plasma Systems

ALB Materials
- ALB MATERIALS -

RARE EARTH MATERIALS

ichor

TMS INTEGRATED GAS SYSTEMS

CHEMICAL DELIVERY SYSTEMS

SPUTTERING TARGETS

HVA

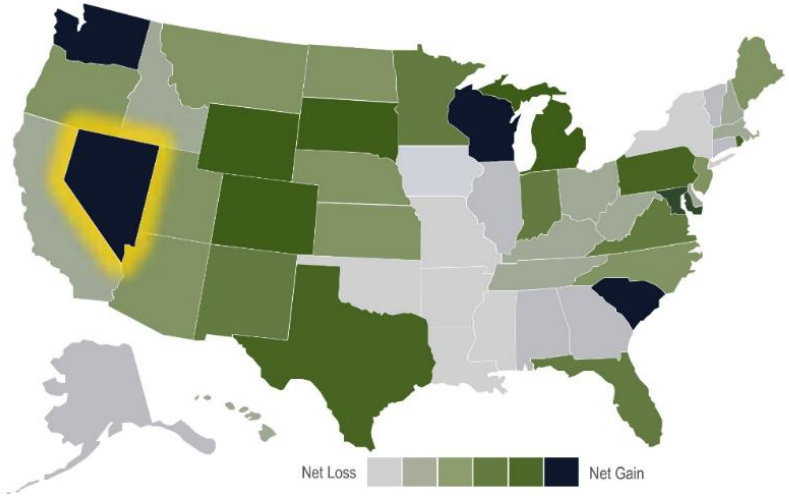
11000 Series Stainless Steel Gate Valves

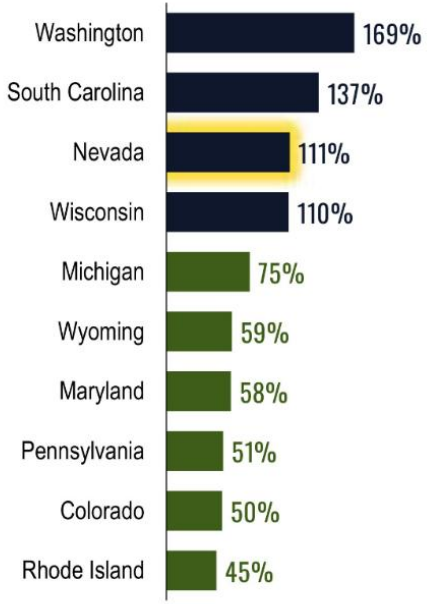
Advanced Specialty Gases
An Iwatani Company

Workforce Education

BRAIN GAIN

Top 10 Educational Gains

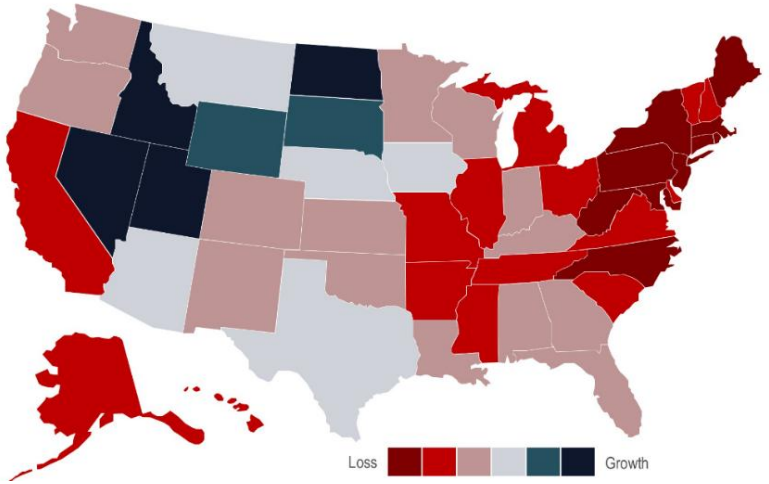


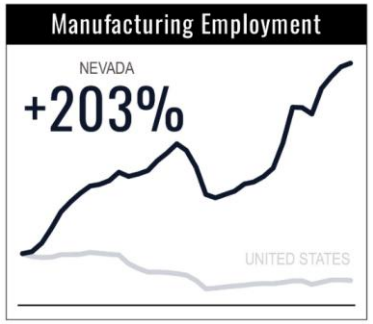


- 35% of current Northern Nevada residents hold Bachelor's or above
  - 48% of newcomers
- 37% of newcomers to Northern Nevada come from California

MANUFACTURING EMPLOYMENT GROWTH

United States | 1990 - 2024





Manufacturing is 12.4% of Reno employment (versus 9.4% US)

Nanofabrication at UNR: Capabilities

Opened: April 2025.

- Lithography & Wet Benches (manual)
  - Heidelberg uMLA (i-line, 4", upgradeable to 6")
  - Vapor Prime Oven, SRD, single-wafer spin/bake
  - Acid Hood, Base (developer) Hood, 3x Solvent Hoods
- Deposition
  - Semicore E-Beam Evaporation (6x15cc crucibles, 4", upgradeable to 6")
  - Semicore Sputterer (6", 3x3" targets, RF, pulsed DC, N_2, O_2)
- Etch
  - Oxford Instruments Cobra 300 ICP RIE w/ cryo + ALE upgrade (2x fast-switch ALE manifolds), Ocean Optics End Point Detection
    - 8x gases (3x toxic). Initial: Ar, He, O_2, H_2, N_2, SF_6, CF_4, CHF_3
  - Anatech Asher (Ar, O_2, CF_4)
- Backend
  - Westbond Dual-Head Wirebonder

SC450-LL Sputtering System with Load Lock

SC2000 PVD Evaporation System

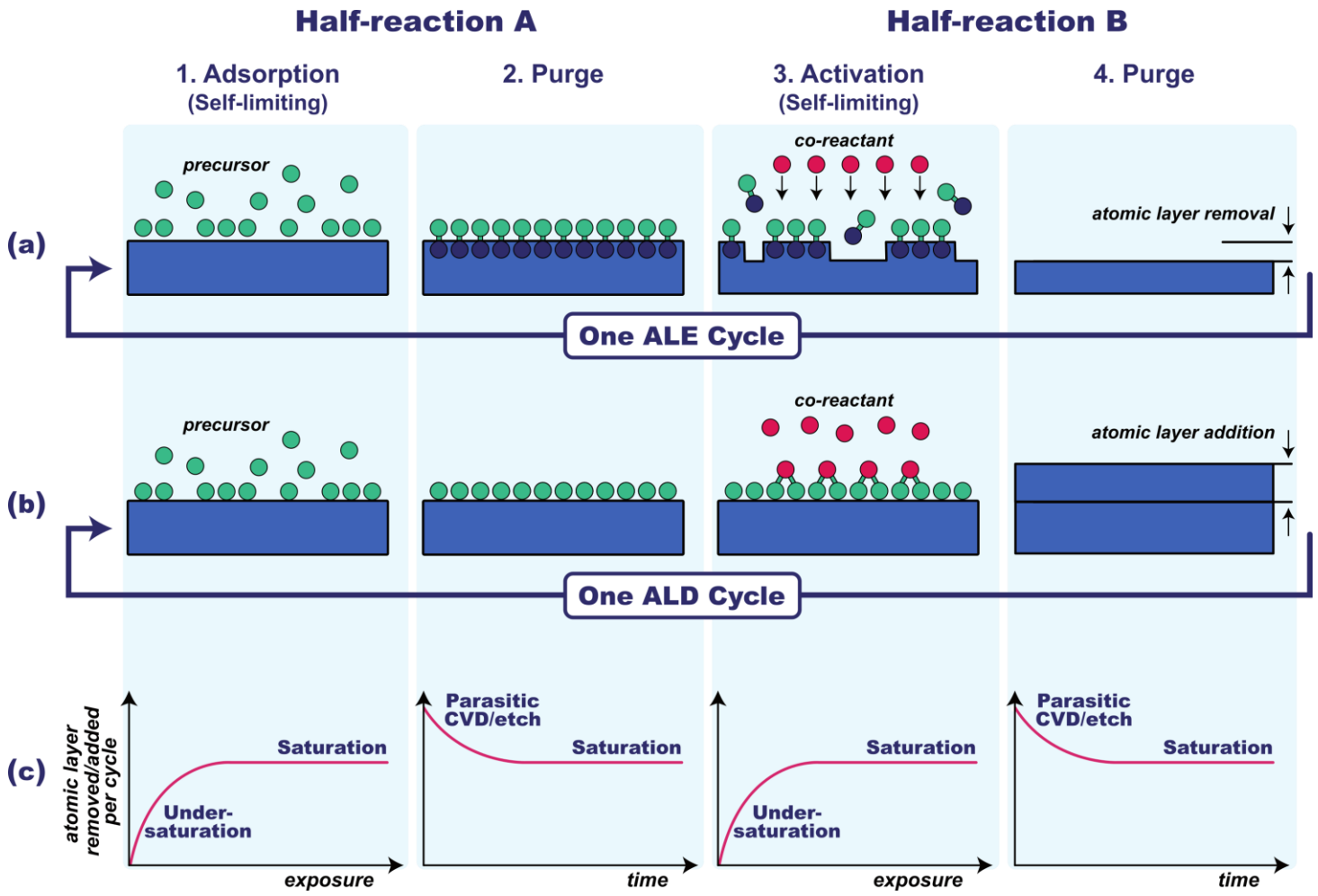
ICP RIE ALE

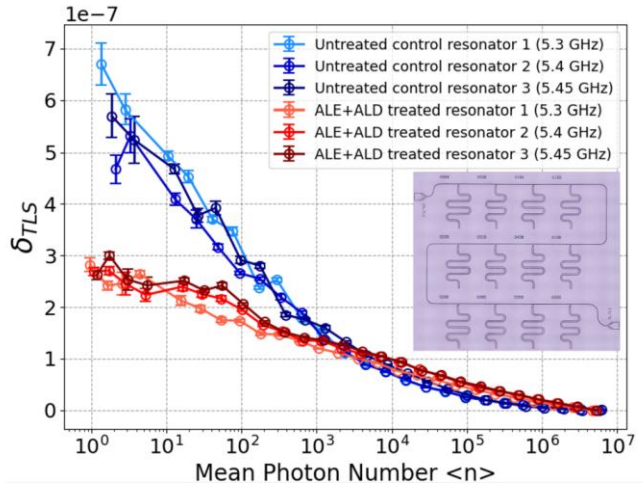
Maskless Aligner

- Metrology & Test
  - Microscope
  - Desktop SEM
  - Filmetrics F20 (PR thickness)
  - Optical Profilometer
  - Dektak Profilometer
  - 4 point probe
  - Probe Station
- Characterization
  - FIB/SEM w/ EDS, AFM, XRD, XPS

Oxford Instruments PE-ALD system (PlasmaPro ASP) arrives June 2026.

Primary Focus Area: Atomic Scale Processing



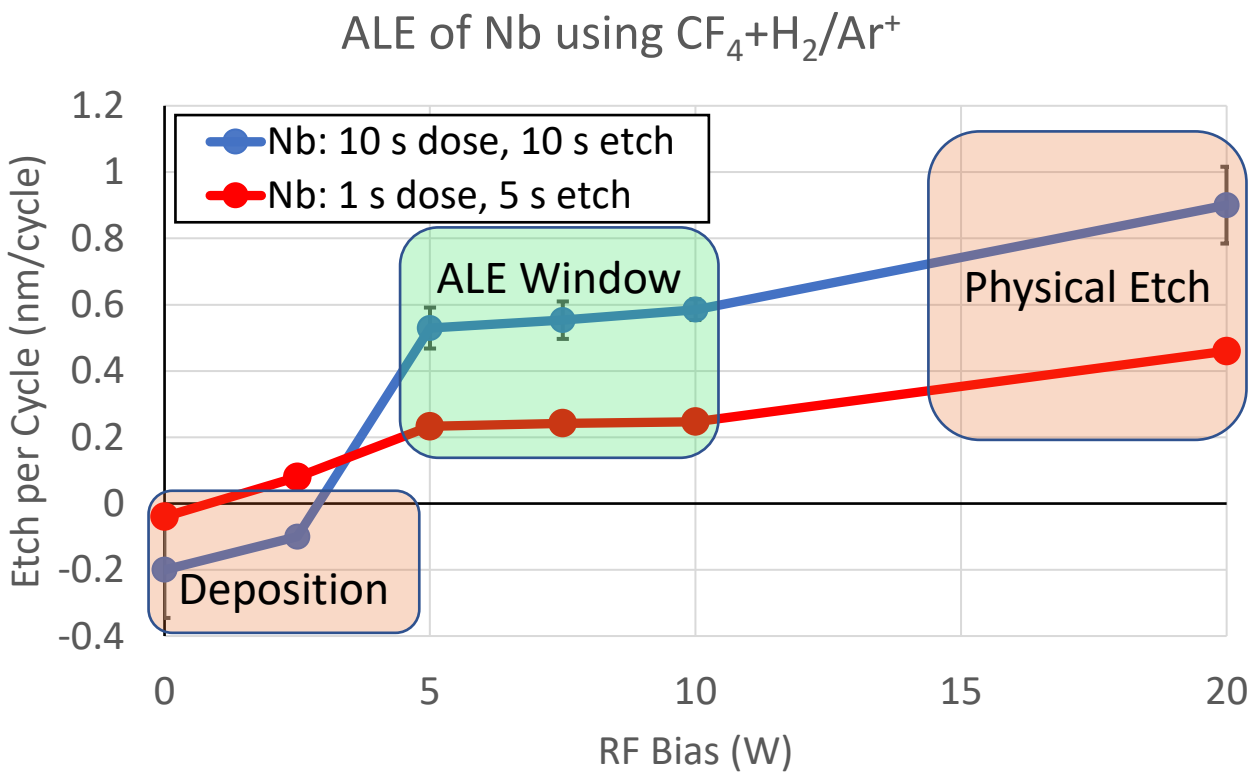


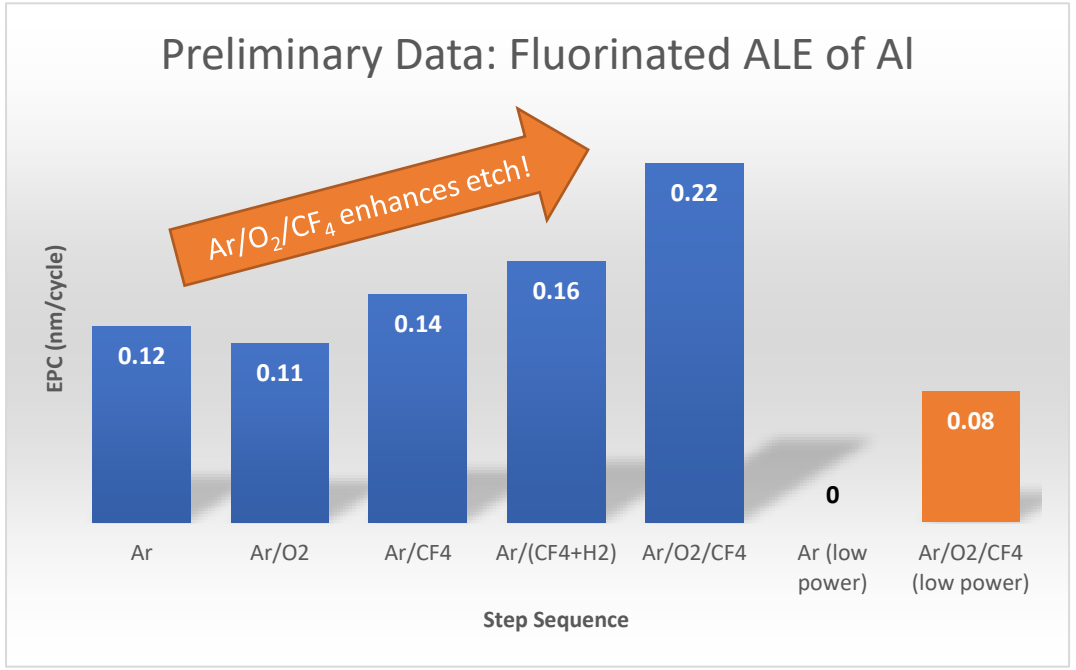
Al Superconducting Qubits

ALE/ALD improved T_1 from 300 µsec → 600 µsec!

Mahuli, Neha, et al. "Improving the lifetime of aluminum-based superconducting qubits through atomic layer etching and deposition." *arXiv preprint arXiv:2506.17474* (2025).

Atomic Layer Etch at UNR

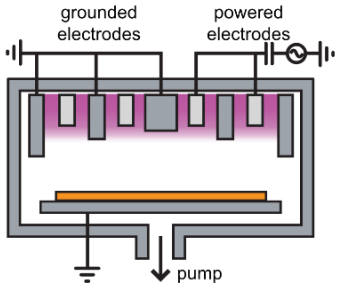




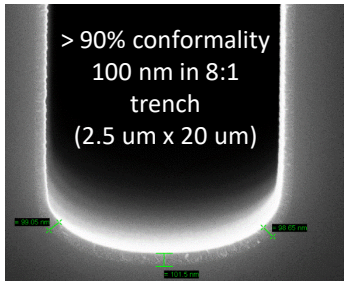
Walsh, Ryan F., Mikeal B. Macera, and J. Russell Renzas. "Atomic layer etch process for Nb and Ta using CF4/H2 plasma." *Journal of Vacuum Science & Technology A* 44.2 (2026).

Future Work: ALD/ALE for Superconducting Qubits

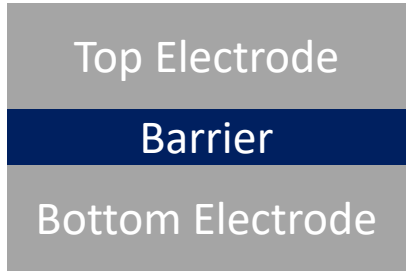
Compact remote plasma



Biased Electrode



Oxford Instruments PlasmaPro ASP



- ALD Barrier + Top Electrode
- ALD/ALE Supercycles
- Barrier Tuning Methods

Island Growth | Rough film | Smooth film

NSF Award Number 2511980

Achievements & External Outreach (10 months)

- Published paper on ALE of Nb & Ta
- Article in Oxford Instruments Magazine
- 2nd Place NCC AVS Poster (Ryan Walsh)
- NCC AVS Scholarship (Burak Okur)
- Talks
  - NCC AVS (~30 viewers)
  - AVS Webinar (120 viewers)
  - Univ. Oklahoma
  - Univ. Oregon
  - Univ. Nevada, Las Vegas
  - Japanese Consulate
  - AVS ALD/ALE (Ryan, July 2026)
  - Gordon Research Conf. (July 2026)

UNR hired ultra-supportive new Dean of Engineering!

Volume 44, Issue 2
March 2026

LETTER | FEBRUARY 03 2026

Atomic layer etch process for Nb and Ta using CF_4/H_2 plasma

Special Collection: Atomic Layer Etching (ALE)

Ryan F. Walsh; Mikeal B. Macera; J. Russell Renzas

Check for updates

+ Author & Article Information

J. Vac. Sci. Technol. A 44, 020403 (2026)

https://doi.org/10.1116/6.0005119 **Article history**

Share Tools

Cyclic atomic layer etch (ALE) processes were developed for sputtered Nb and Ta thin films using CF_4/H_2 ICP plasma and Ar^+ irradiation. The processes were investigated as a function of CF_4/H_2 dose time, Ar^+ exposure time, and RF substrate bias. Etch per cycle, synergy, and surface roughness before and after etch are reported. Etch rates were similar for both materials for identical process conditions. A soft-saturated ALE process had etch rates of 0.23 ± 0.02 nm/cycle for Nb and 0.23 ± 0.01 nm/cycle for Ta with a total cycle time of 16 s. Synergies were 87% and >99% for Nb and Ta, respectively. Selectivity to Si is also reported. These processes are promising for real-world devices, which are sensitive to etch-induced damage, such as superconducting resonators.

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REFERENCES

- Added corporate & other research group users
- Hired & Trained 2x graduate students
- Hired & Trained Staff Member
- 20 students did basic photolith. training
- Nevada Summer Engineering Academy
- Developed Nanofab course for Spring ’27
- Developing Quantum Devices course for Fall ’27
- Accepted Molecular Foundry access proposal
- Proposal Review Board: LBNL Mol. Foundry

Expanding the UNR Fab

Operations

OIPT ASP
- $1.1M, NSF MRI
- Funded

New NNCI (Quantum West)
- $300k/yr x 5 yrs
- Stanford, UNR, UC Davis, SJ State collab.
- Submitted

Appropriations
- $2M x 1 yr, all equipment
- Submitted

Research

InGaAs ALE HEMTs
- $95k/yr x 3 yrs
- Funded, InGaAs w/ Caltech

ALD/ALE for Qubits
- $230k/yr x 4 yrs
- Submitted w/ SLAC & LBNL

ALE for GaAs Single Photon Emitters
- $125k/yr x 3 yrs
- Submitted, w/ Oklahoma

More ALD/ALE for Qubits
- $200k/yr x 3 yrs
- Preproposal submitted w/ Oregon

AI for Superconductor ALD/ALE
- $150k/yr x 3 yrs
- Preproposal submitted w/ Johns Hopkins

Education

Nevada Tech Hub
- $100k, 1 yr (renewable)
- 1 week summer programs in fab
- Funded

PINES Consortium
- $250k, 1 yr (funded)
- Boise State lead, big collab.
- K12 Outreach, week-long UG programs
- Internships are major goal

Plasma System Manufacturing
- $50k, 1 yr (internal)
- Parts for 3x simple plasma systems
- Students will learn to build systems hands-on

Working with UNR's Nanofab

Sponsored Research

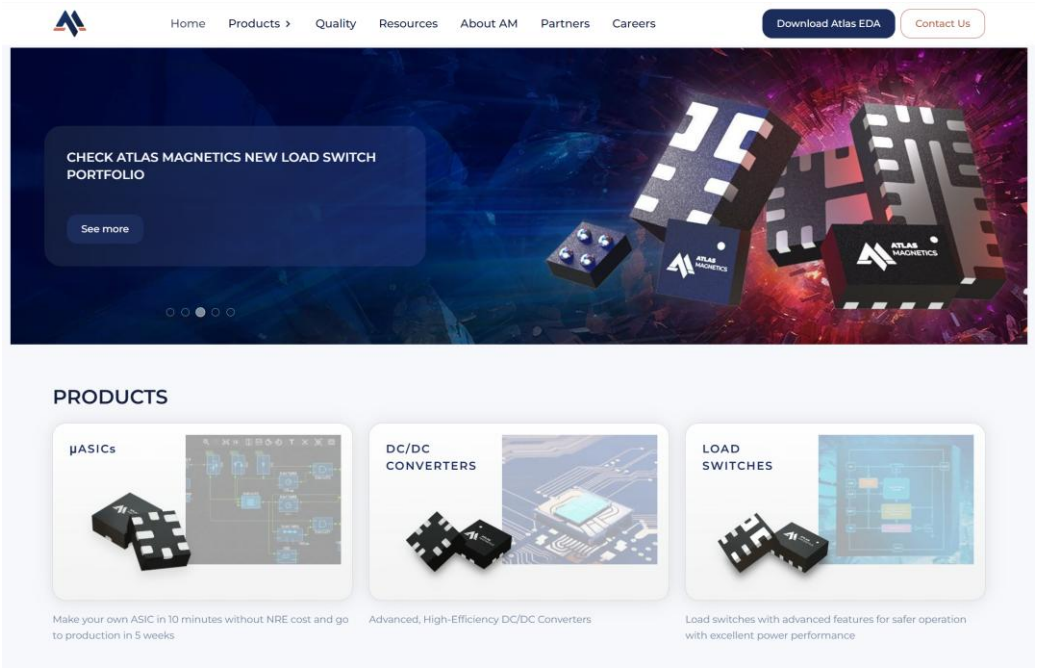
- 1-4 year projects
- Graduate student research
- $100k/yr typical

Talent Pipeline

- Student training programs
- Internships

Corporate Use

- Your employee
- Our tools, facility, and training
- Hourly rate for tool use



Success Story!

- Atlas Magnetics: UNR Cleanroom Corporate User developed new technical solution, now using to specify equipment for new factory

To become a user contact: Russ Renzas (rrenzas@unr.edu) or Rebecca Albion (ralbion@unr.edu)

Thank You!

Russ Renzas

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University of Nevada welcomes a new nanofabrication lab to campus

SMART NV℠

Research + Education → Economic Development