Postdoc-L: New Postdoc Introduction

Spring 2019 Semi-Annual Meeting
Iowa State University, Ames, IA
April 3-5, 2019

Staff: Jonah Klemm-Toole (Mines)
Faculty: Amy Clarke (Mines) and Kester Clarke (Mines)
Industrial Mentors: TBD

Experience and Education

- **(2000 – 2002)** Applied Welding Technology, Santa Fe Community College
- **(2001 – 2007)** Welder, Gainesville Welding & Fabrication
- **(2002 – 2008)** B.S. Materials Science & Engineering, University of Florida
- **(2008 – 2013)** Process Engineer, Power Systems Manufacturing
- **(2013 – 2019)** Ph.D. Metallurgical and Materials Engineering, ASPPRC, Mines
- **(2019 – Current)** Postdoc, Metallurgical & Materials Engineering, CANFSA, Mines

Welder
Gainesville Welding & Fabrication

CANFSA
CENTER FOR ADVANCED NON-FERROUS STRUCTURAL ALLOYS

Gas Tungsten Arc Welding (GTAW)


[1]

Gas Metal Arc Welding (GMAW)


[2]

Manufactured stairs, ladders, and handrails using GTAW and GMAW
Worked with carbon steels, stainless steels, aluminum alloys

[1] http://achmadarifin.com/gtaw-welder-welding-career-choice
[2] https://www.waybuilder.net/free-ed/SkilledTrades/Welding/10GMAW/10GMAW.asp

Process Engineer
Power Systems Manufacturing

CANFSA
CENTER FOR ADVANCED NON-FERROUS STRUCTURAL ALLOYS

Chemical Stripping

Used to remove oxidation resistant coatings from engine run components

Fluoride Ion Cleaning

Used to remove oxidation from cracks formed during engine service

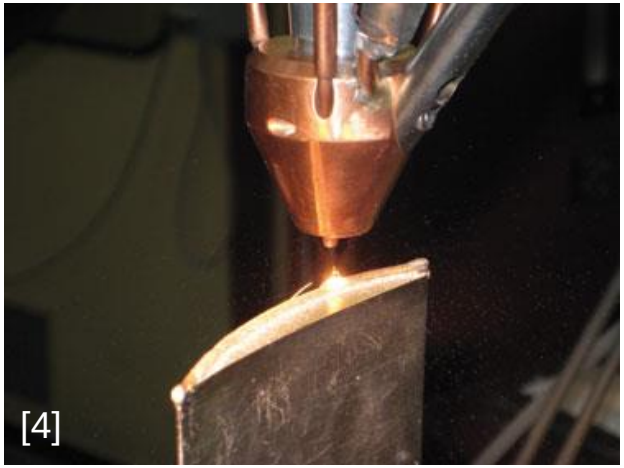
Chemical stripping and fluoride ion cleaning processes were developed to prepare Ni and Co based superalloy airfoil components for subsequent repair processes

[3] https://www.galvatek.eu/process-plants/chemical-stripping-lines/
[4] http://www.ticoating.com/hf-ion-cleaning/

Process Engineer
Power Systems Manufacturing

CANFSA
CENTER FOR ADVANCED NON-FERROUS STRUCTURAL ALLOYS

Directed Energy Deposition



Manual GTAW

Vacuum Diffusion Brazing

Laser Powder Bed Fusion

Multiple advanced manufacturing processes were developed to enable industrial gas turbine airfoil repair

[5] http://keywordsuggest.org/gallery/1291949.html
[6] https://psm.com/media/PSM_Reconditioning.pdf
[7] https://www.chromalloy.com/commercial-aviation/operators/repairs/value-chain/repairs.aspx

PhD Research
Improving Fatigue Performance of Nitrided Gear Steels

CANFSA
CENTER FOR ADVANCED NON-FERROUS STRUCTURAL ALLOYS

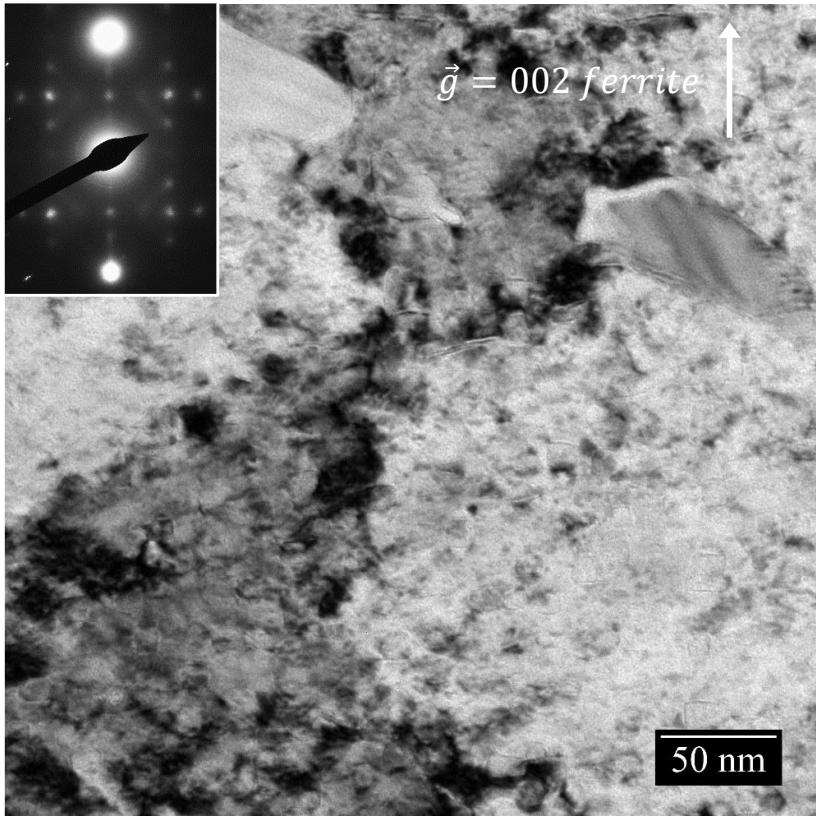
- *Evaluated influences of vanadium (V) and silicon (Si) content on:*
  - *Microstructure*
  - *Hardness*
  - *Residual Stress*
  - *Fatigue performance*
- *Developed compositions that show superior fatigue performance compared to conventional alloys after nitriding*

[8] http://www.nitrex.com/nitriding-applications-materials/nitriding-nitrocarburizing-applications

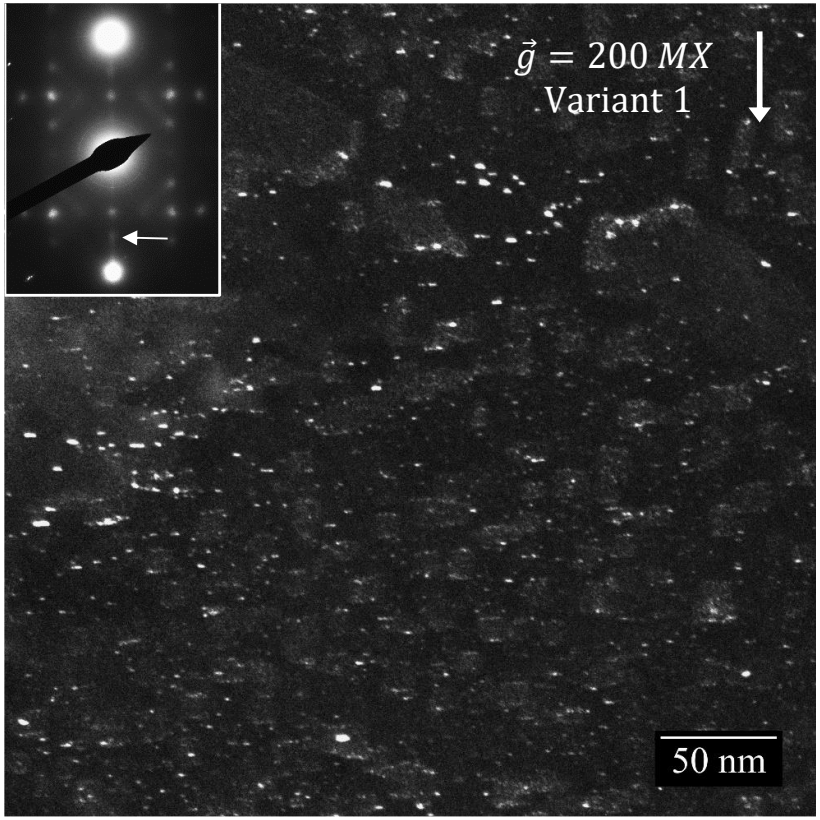
PhD Research
Quantitative TEM

CANFSA
CENTER FOR ADVANCED NON-FERROUS STRUCTURAL ALLOYS

TEM BF of Nitrided Case Region

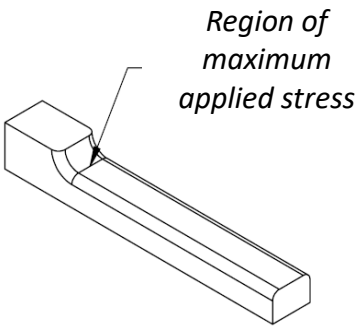


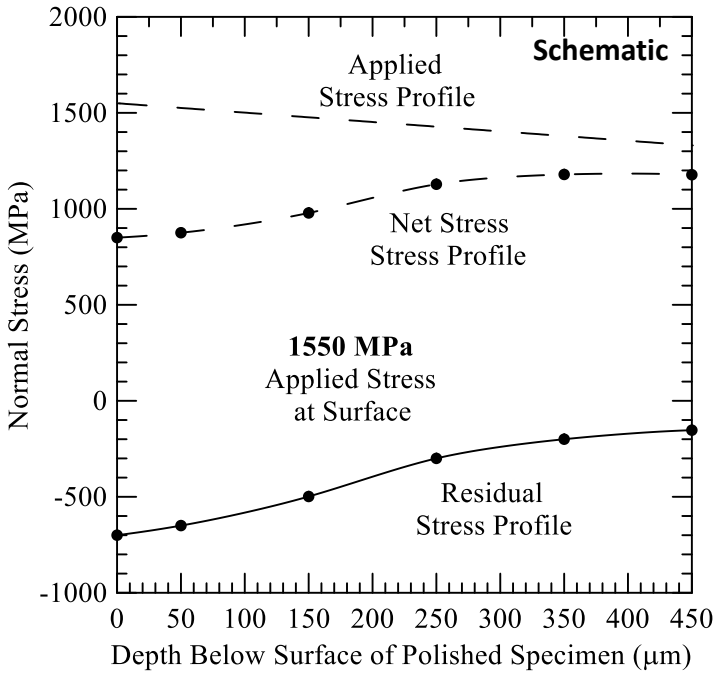
TEM DF of MX Phase in Case

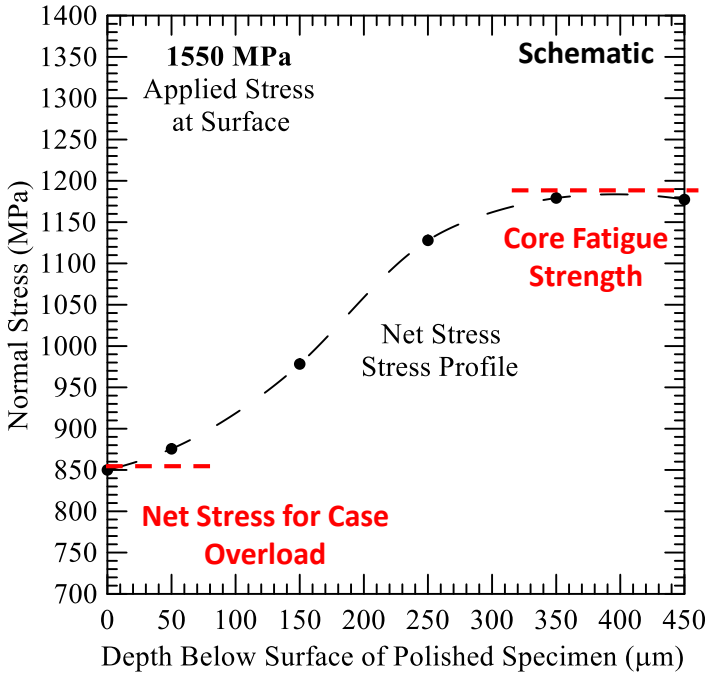


Combined TEM DF imaging & CBED thickness measurements to evaluate volume fractions of fine low volume fraction phases

PhD Research
Fatigue Performance

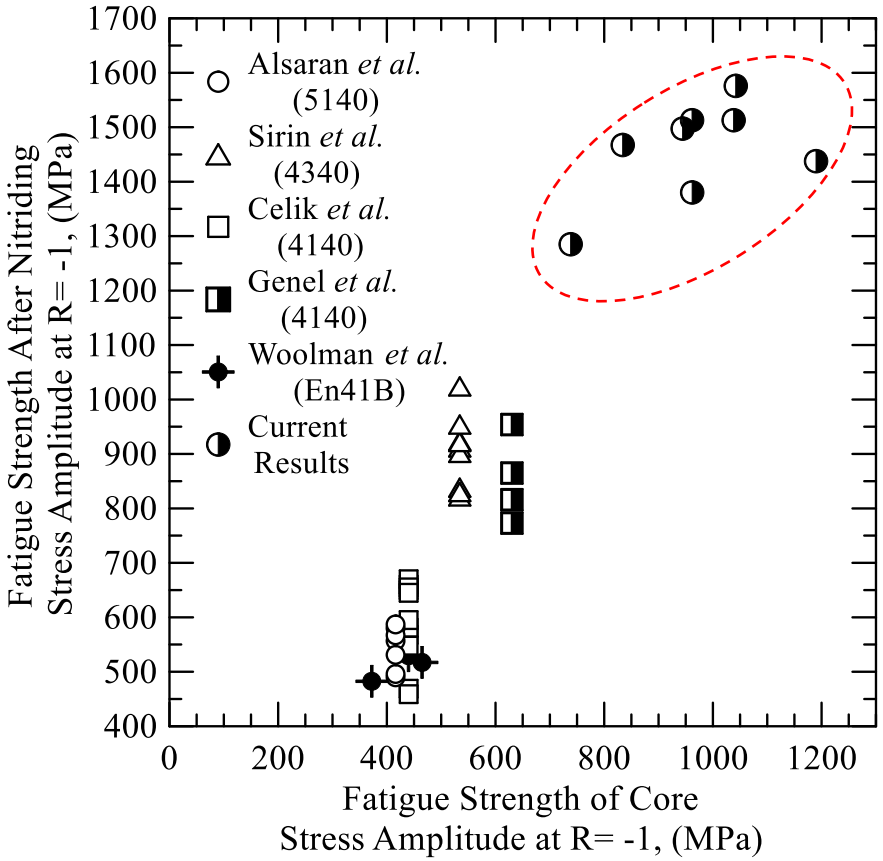






In order to improve fatigue performance, core fatigue strength and compressive residual stress must both increase

PhD Research
Fatigue Performance

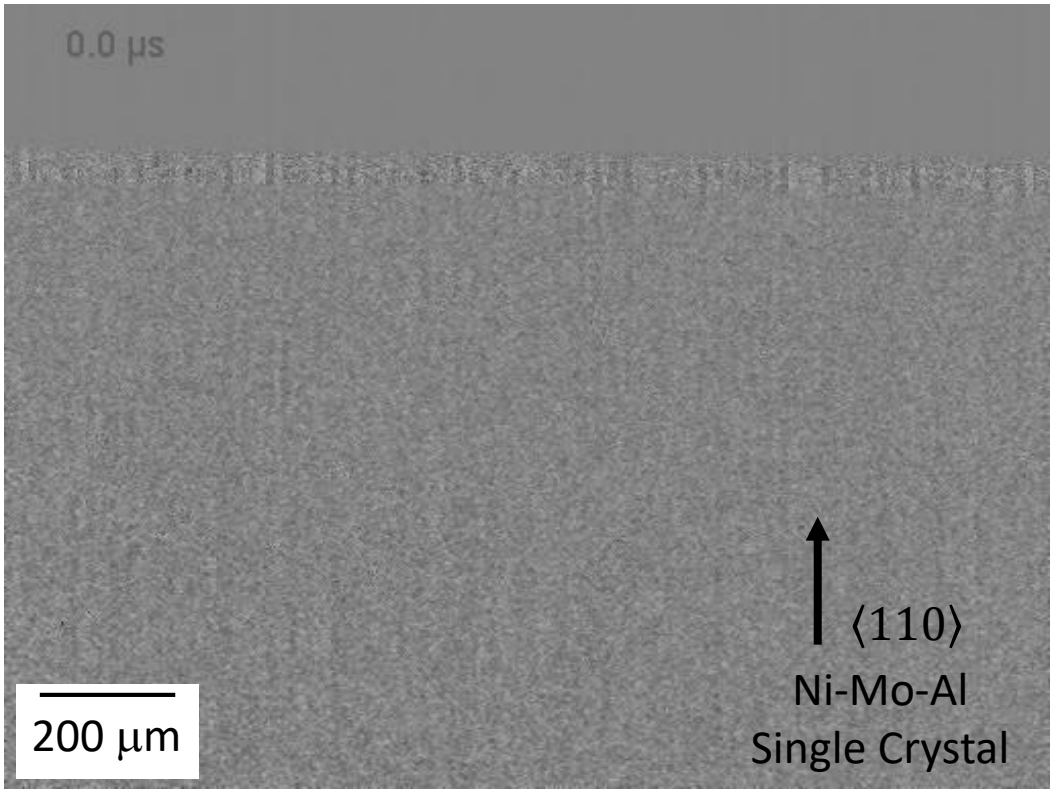


Superior fatigue performance compared to conventional alloys due to higher core fatigue strength and compressive residual stress

CANFSA Postdoc Research Solidification of Additively Manufactured Ni Based Alloys

CANFSA
CENTER FOR ADVANCED NON-FERROUS STRUCTURAL ALLOYS

High speed x-ray radiography of solidifying laser spot melt pool obtained at the Advanced Photon Source (APS)



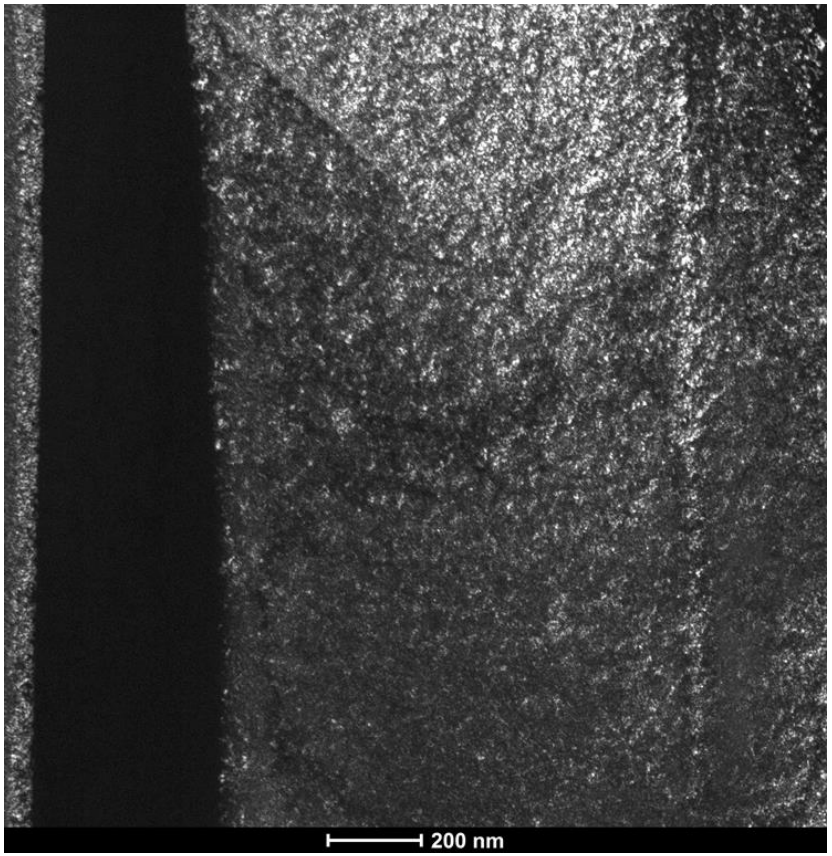
Objectives

- *Understand the role of crystallographic orientation and laser melting conditions on microstructure selection and texture development*
- *Use measured velocity of solid-liquid interface to calibrate phase field models to calculate thermal gradients*
- *Use EBSD to evaluate microstructures*

CANFSA Postdoc Research Influence of ω Phase on TRIP Behavior in β–Ti Alloys

CANFSA
CENTER FOR ADVANCED NON-FERROUS STRUCTURAL ALLOYS

TEM DF of ω phase in Ti-10V-2Fe-3Al strained to 0.5 %



Micrograph courtesy of Y. Guo

Objectives

- *Understand how ω phase precipitation affects TRIP in the metastable β–Ti alloy Ti-10V-2Fe-3Al*
- *Use TEM DF imaging and foil thickness measurements of evaluate the size and volume fraction of ω phase*
- *Relate ω phase precipitation characteristics to TRIP behavior observed during tensile testing*

Office of Naval Research ONR Science & Technology

Thank you!

Jonah Klemm-Toole
jklemmto@mines.edu