

# Sialon Materials Development

Work performed under Contract 4000017596:  
Hot Section Materials Development  
of Advanced Microturbines.

*Engineering  
Your  
Competitive  
Edge*

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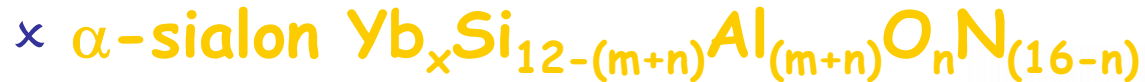
# Sialon Material Objective

- Demonstrate sialon's potential for microturbine hot-section component.
- Establish processing capability baseline
- Sialon material optimization



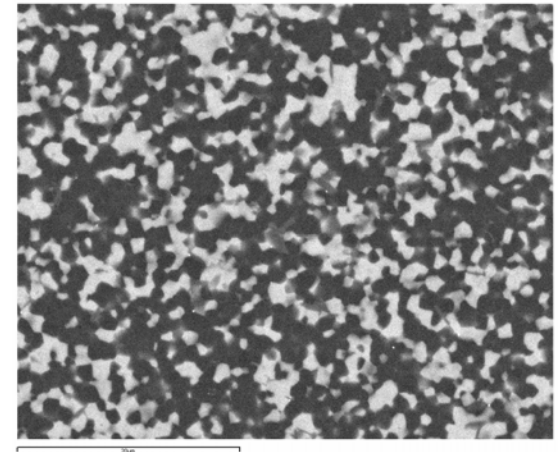
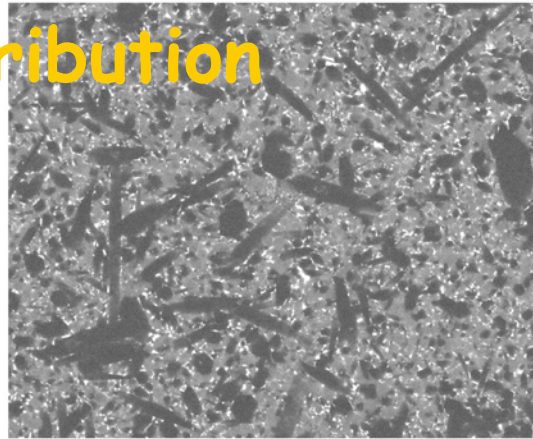
# Sialons Greater Complexity

- Solid Solution



- Grain boundary

- Grain distribution



# Task 1 Progress

- **Sialon Screening**

- × **Composition Matrix**

- Four with b-sialon w/ z ~ .35
- Four with b-sialon w/ z ~ .8
- Two rare earth levels.

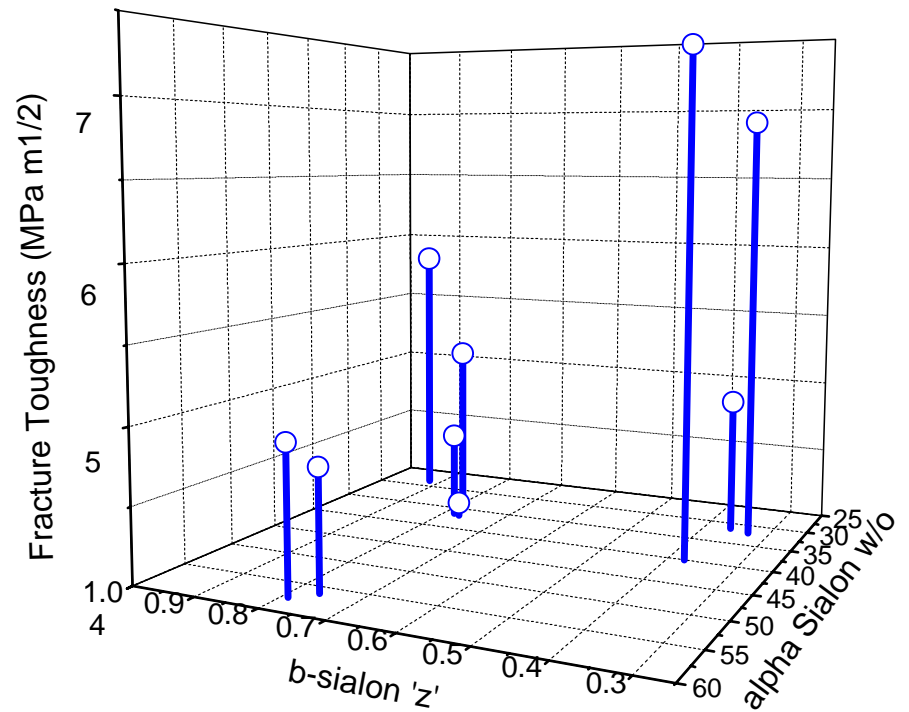
- × **Mechanical Properties**

- Toughness, strength, hardness

- × **Sialon Characterization**

- Microstructure
- TEM, EPMA analysis at PSU
- Sialon phases

- Best Toughness at moderate alpha sialon contents and low b sialon z



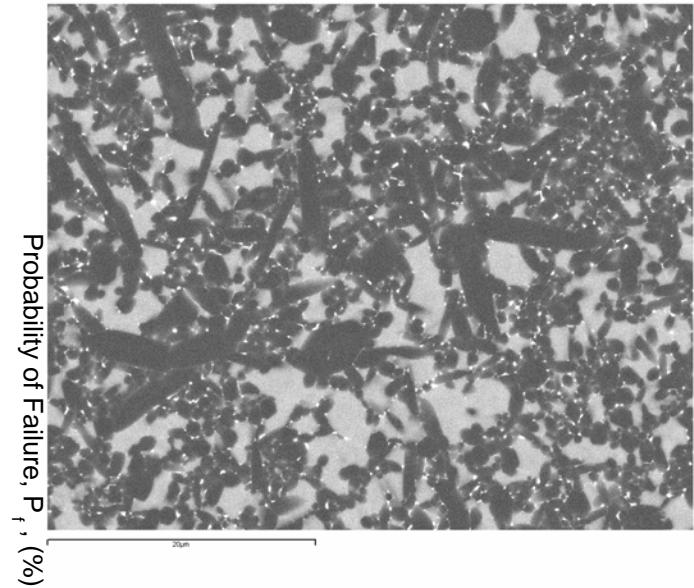
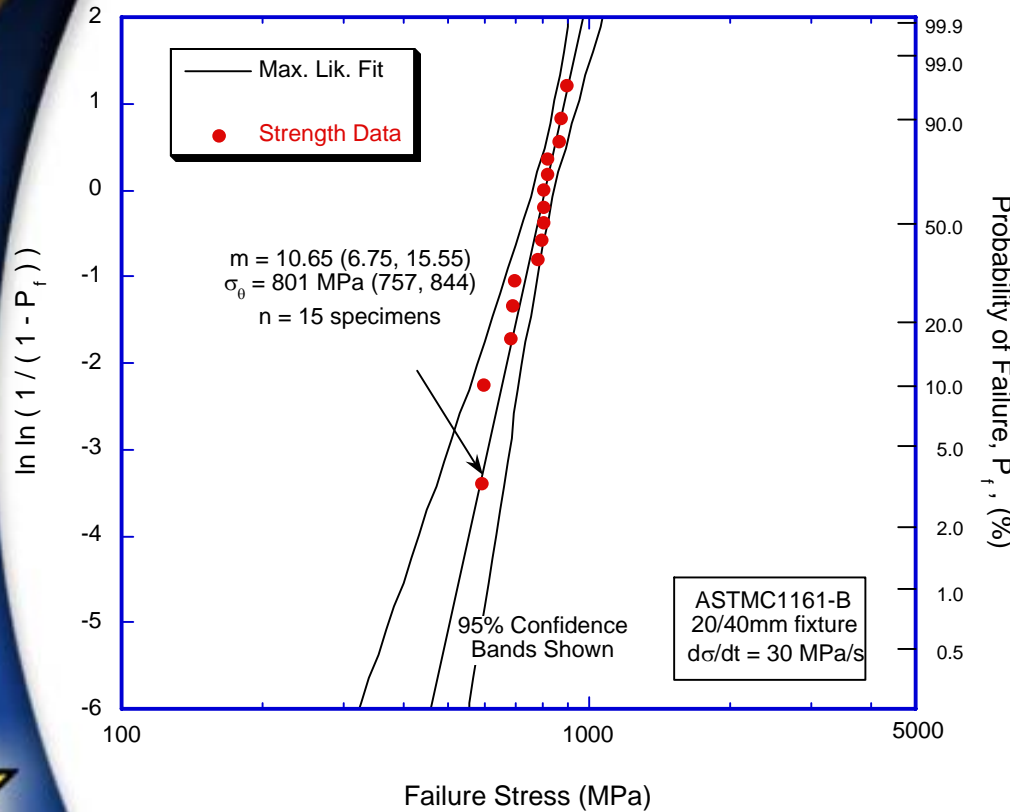
# Mechanical Testing Status

- Mechanical testing nearing completion.

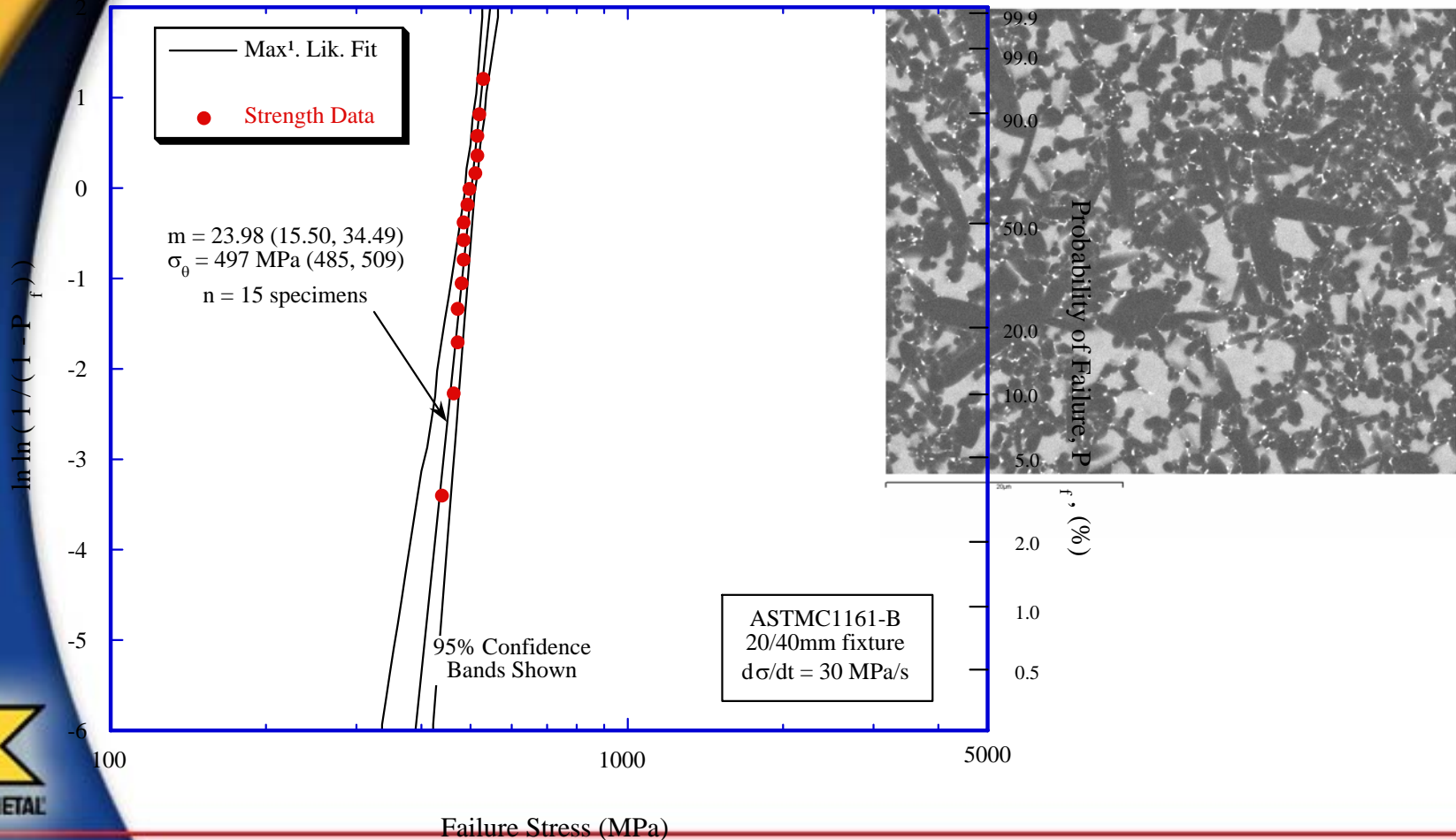
Sialon	HIP*	Fast Fracture (Mpa)				a sialon	b sialon	a sialon
		RT	weibull	1204	weibull	w/o	z'	x'
ab831	1800 / 30	960	8.45	607	10.54	31.9	0.33	0.26
ab582	1800 / 30	567	7.21	331	8.88	57.6	0.79	0.40
ab531	1900 / 120	801	10.65	497	23.98	28.3	0.92	0.41
ab832	1800 / 30	783	6.06				0.38	0.25
ab532	1900 / 120	651	5.92	393	9.79	31.4	0.82	0.40
ab132	1800 / 30	878	6.39	507	8.6	61.1		



Kennametal SiAlON-AB531  
Uncensored Flexure Strength Distribution  
20°C - 30 MPa/s - Longitudinally Machined



Kennametal SiAlON-AB531  
Uncensored Flexure Strength Distribution  
1204°C - 30 MPa/s - Longitudinally Machined

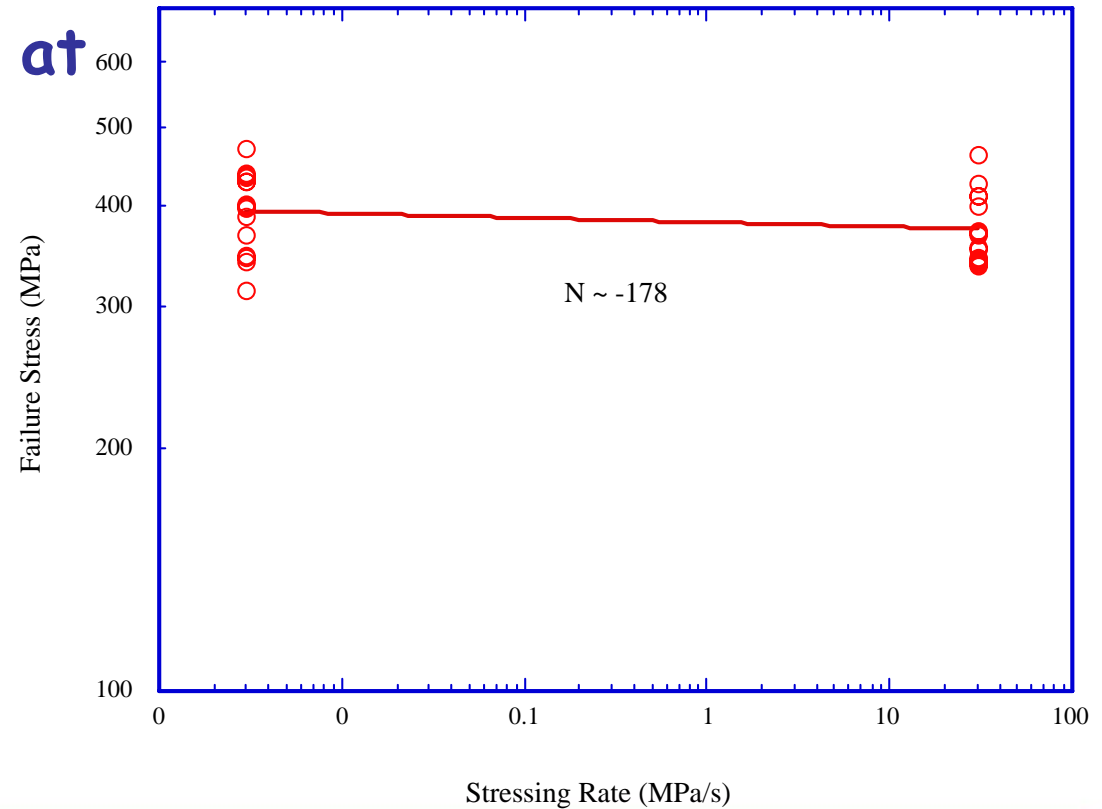




# Fatigue Resistance

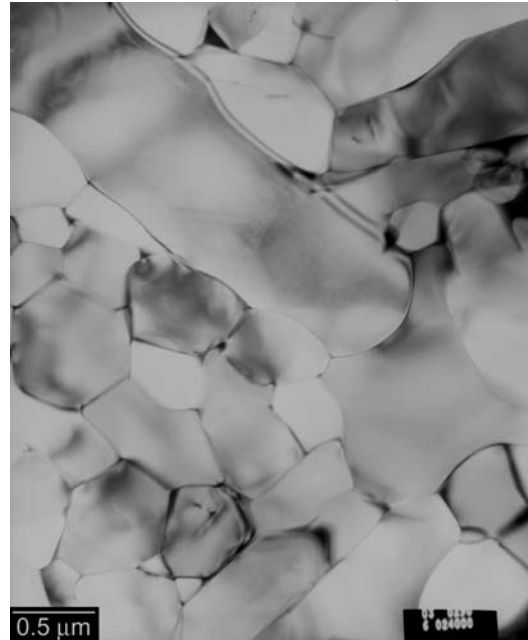
- Data available for one sialon at this time

Dynamic Fatigue of SiAlON-2308A  
Uncensored Flexure Strength  
As-Machined Surface

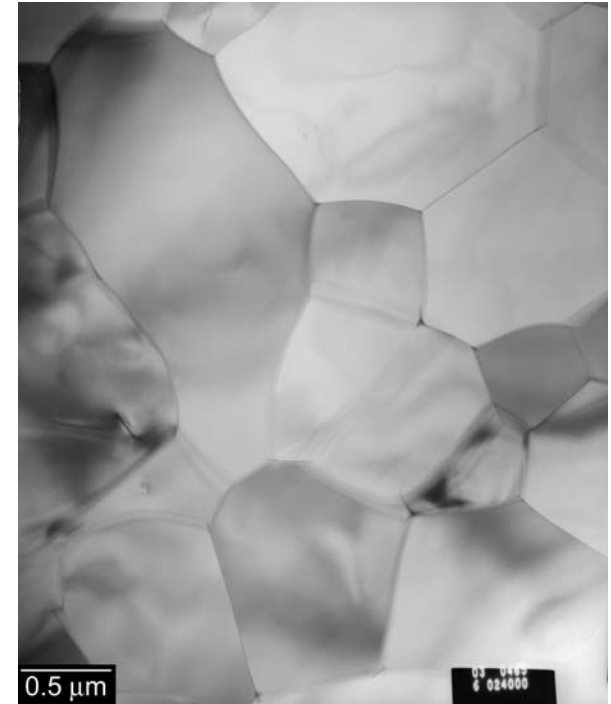
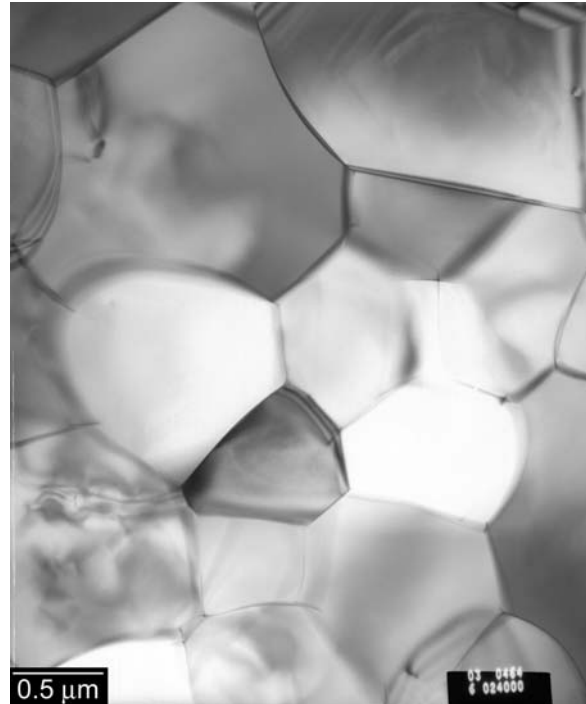


# Overview of ab831 microstructure

- Sialons with  $z \sim .3$ 
  - × Similar grain boundary distribution  
Lower Yb content in alpha

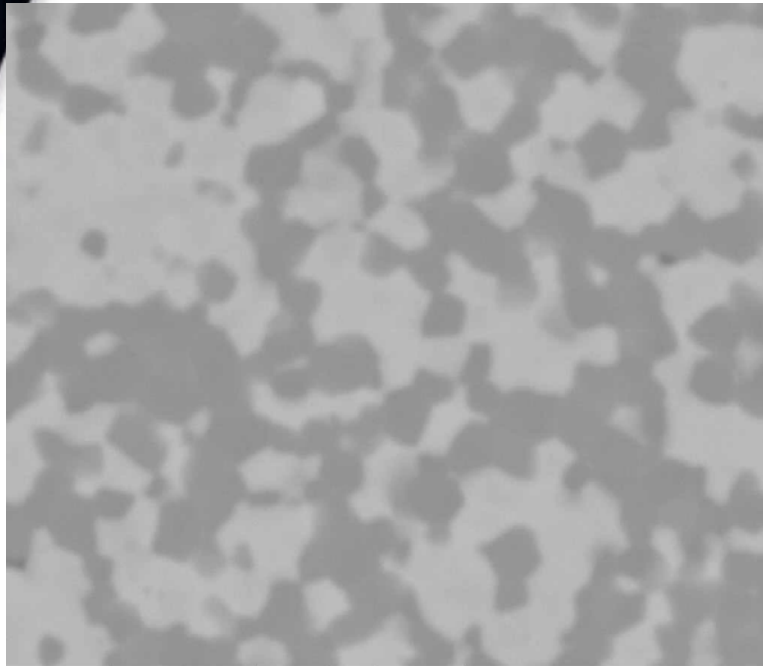


# Overview of ab582 microstructure

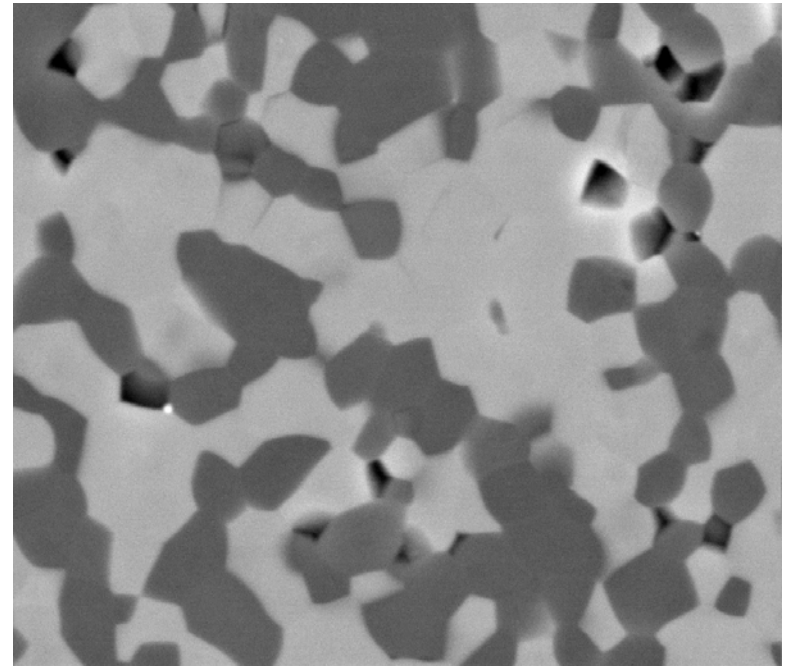


- Reduced Aspect Ratio
- Lower volume of grain boundary phase

# Effect of heat treatment



5/7/2003 WD Mag HV Det Pressure 10.0µm  
2:40:04 PM 8.5 mm 10000x 15.0 kV SSD 0.53 Torr



8/30/2003 WD Mag HV Det Pressure 10.0µm  
2:58:46 PM 8.6 mm 9867x 15.0 kV SSD 0.30 Torr

ab582 before heat treatment

ab582 after heat treatment

- Not much change in grain size

# Summary and Planned Activity

- Significant microstructural variation within sialon matrix.
  - x Mechanical property dependence on sialon
- Select two sialons for complete mechanical characterization.
- Sialon modifications
  - x HIP temperature
  - x Slight composition changes
  - x Methods to enhance toughness
- Prepare tile for environmental testing