

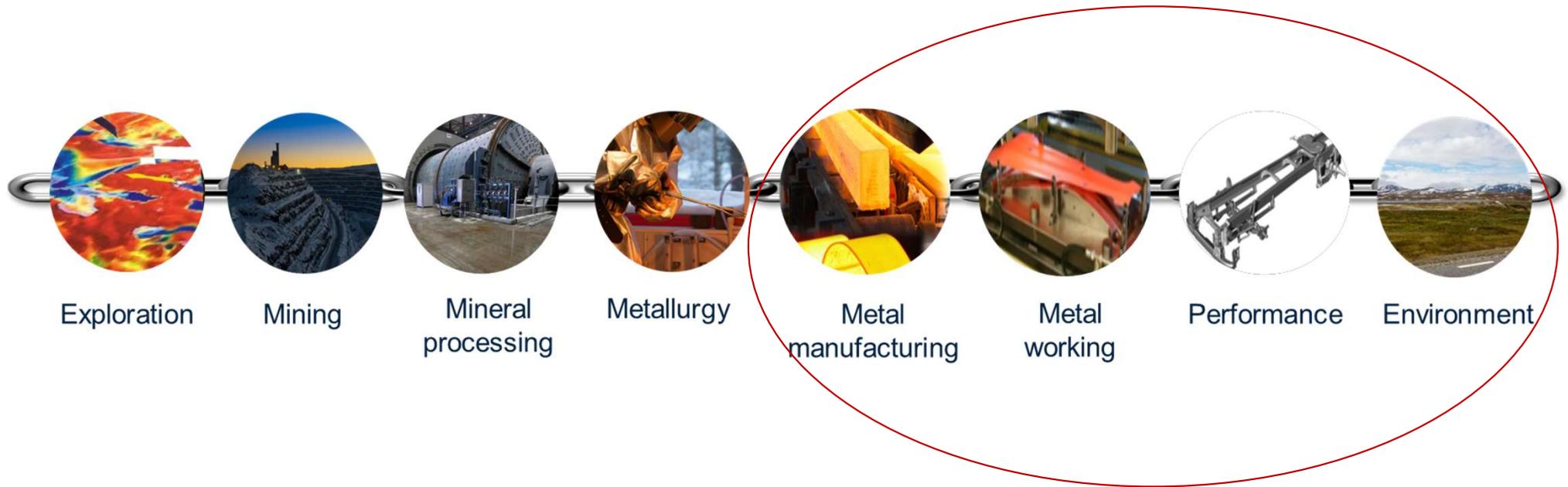
# THE ROLE OF THE MICROSTRUCTURE

Marta-Lena Antti, Professor Engineering Materials

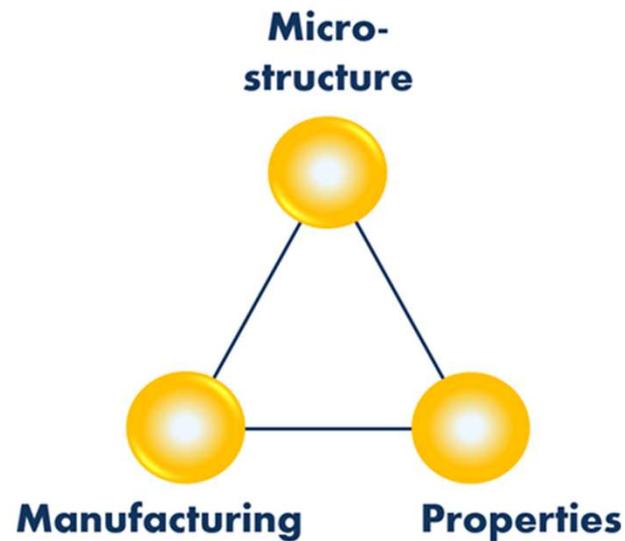
LULEÅ  
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UNIVERSITY  
OF TECHNOLOGY

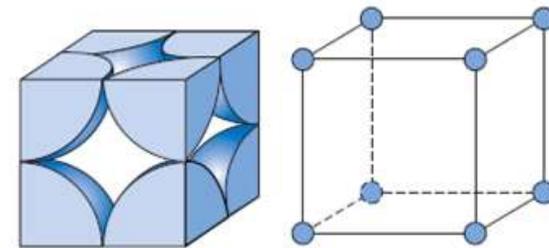
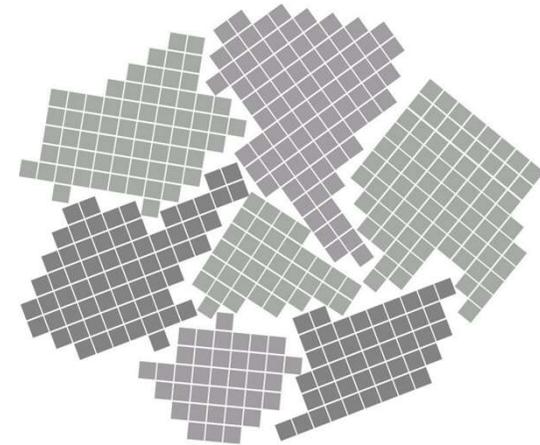
# METALS AND ALLOYS VALUE CHAIN



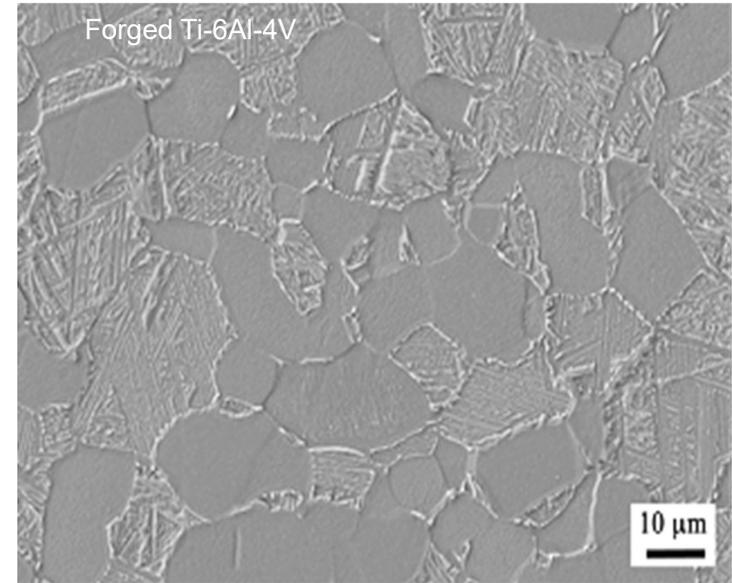
# METALS AND ALLOYS VALUE CHAIN



# WHAT IS A MICROSTRUCTURE?



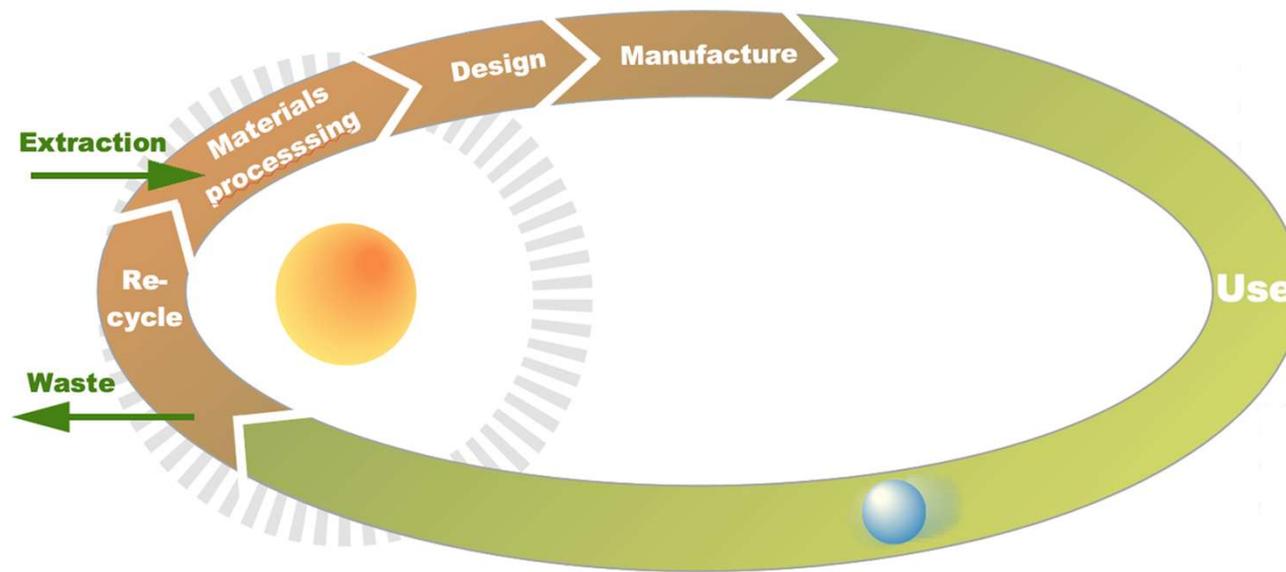
# WHAT IS A MICROSTRUCTURE?



# MICROSTRUCTURE RULES PROPERTIES!

*Strength*  
*Ductility*  
*Wear*  
*Fatigue*  
*Weldability*  
*Formability*  
*Corrosion*  
*Creep*

...



“Extraction-to-recycling loop” – increase user phase by increasing material performance

# EXAMPLE 1: IRON ORE PELLET PRODUCTION



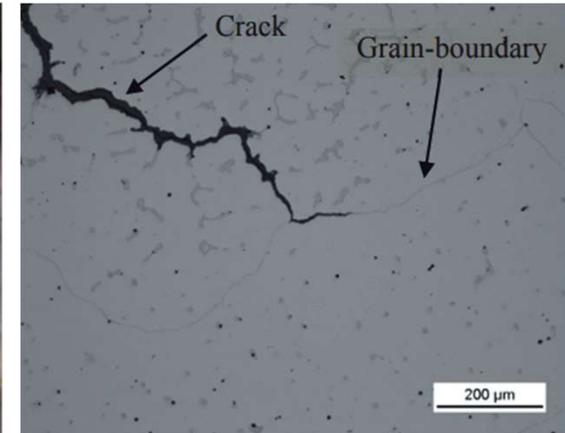
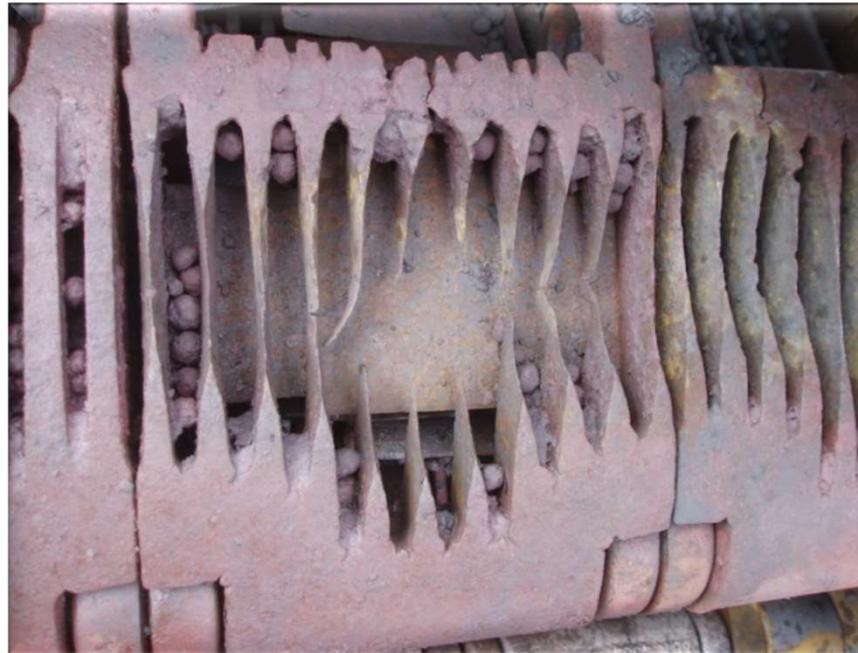
KK4, LKAB, Kiruna



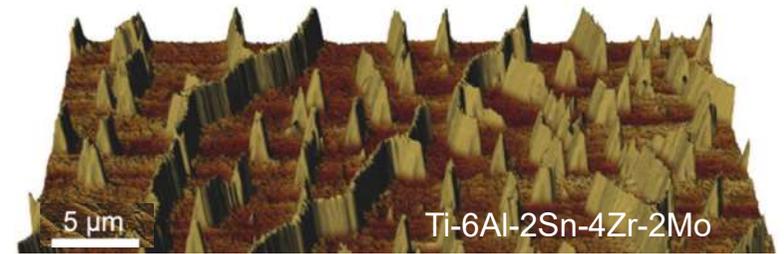
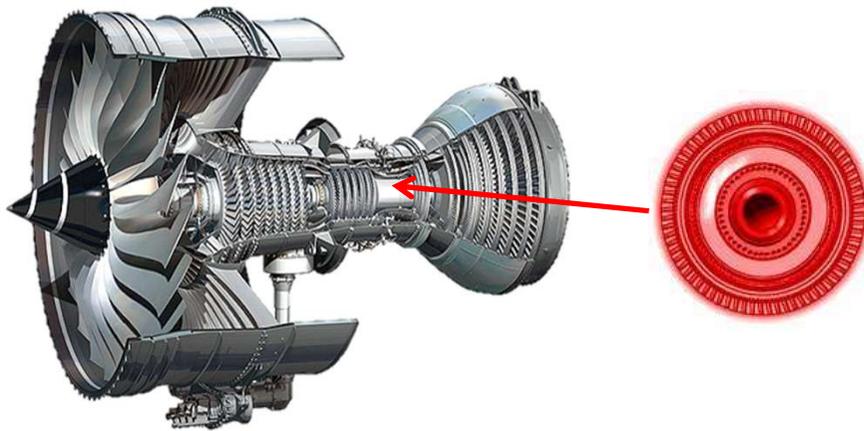
Rotary Kiln, 1350° C.  
Length: ~ 40 m. Diameter: ~ 6.5 m



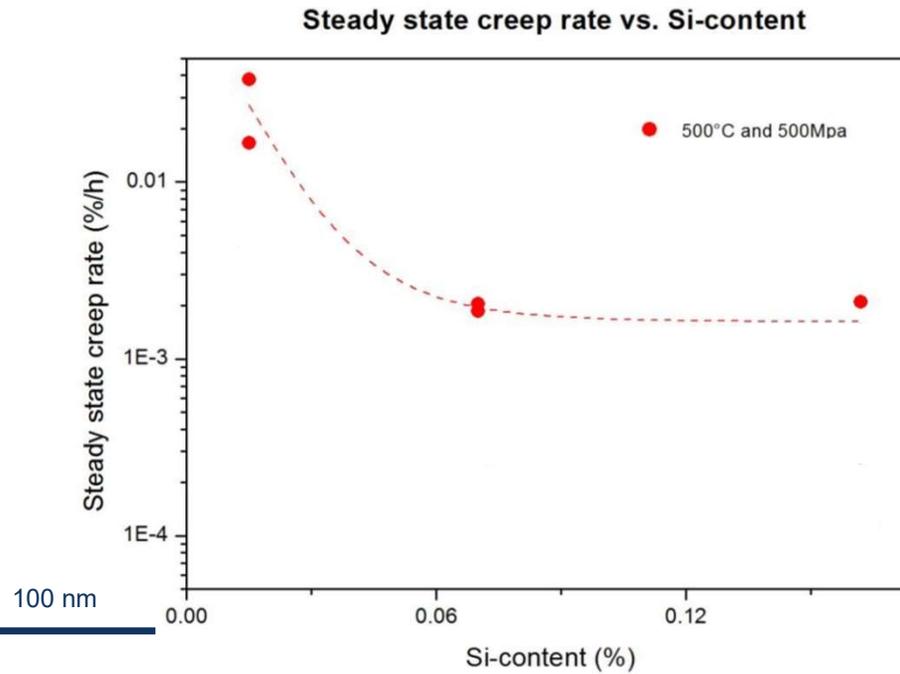
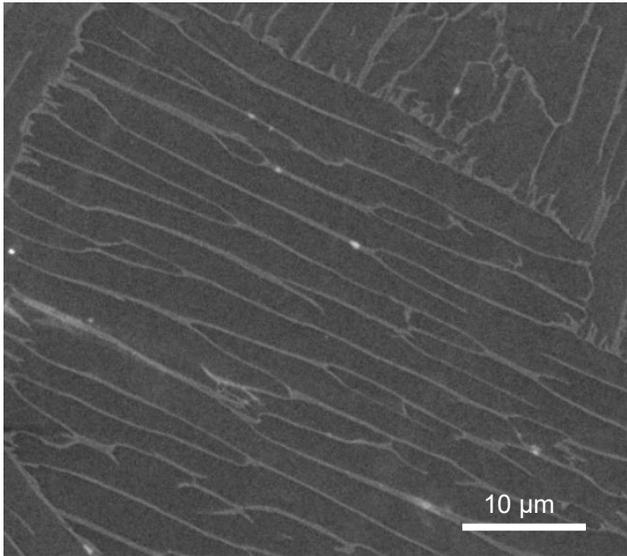
# EXAMPLE 1: IRON ORE PELLET PRODUCTION



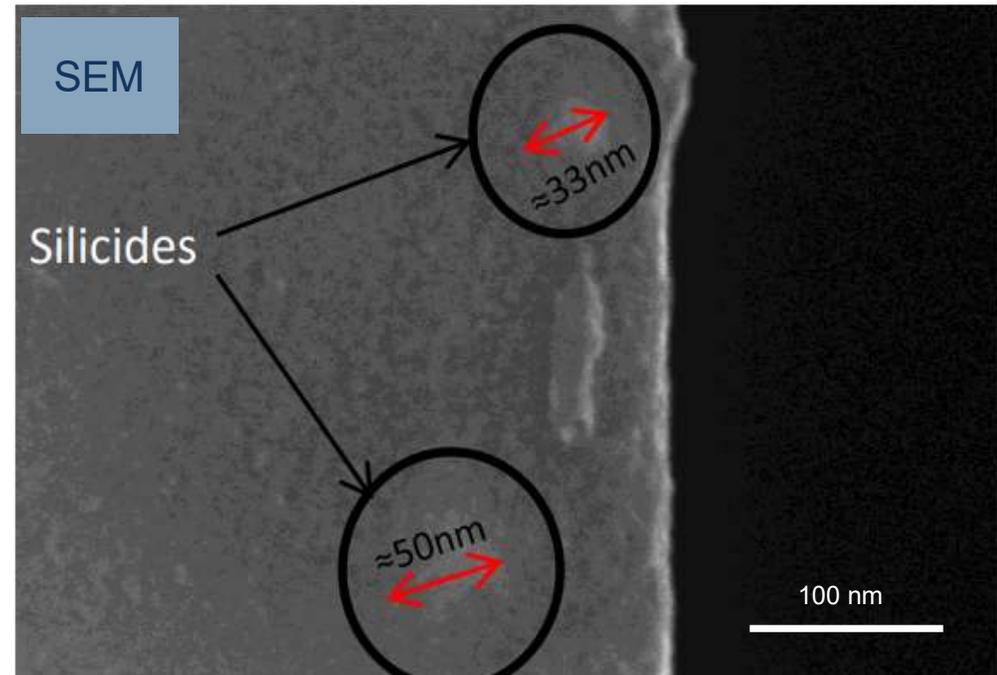
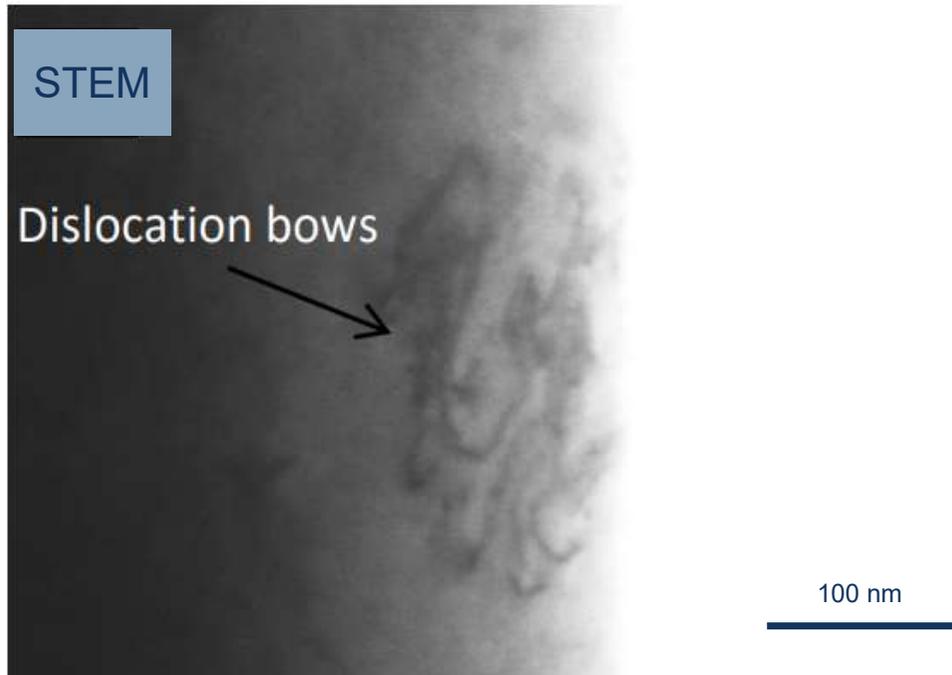
## EXAMPLE 2: JET ENGINES



# IMPROVING HIGH TEMPERATURE PROPERTIES

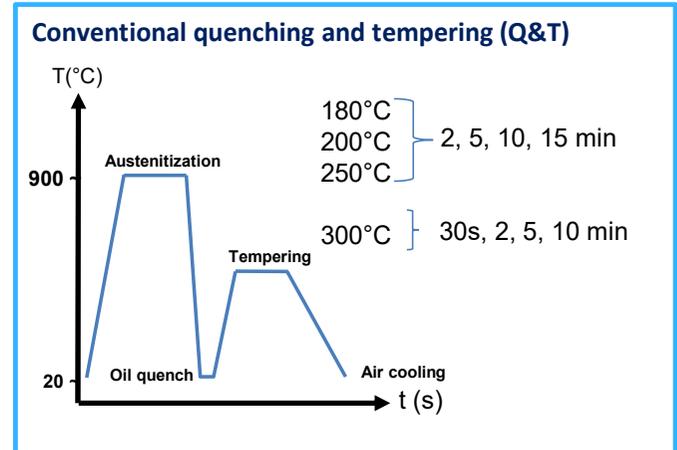
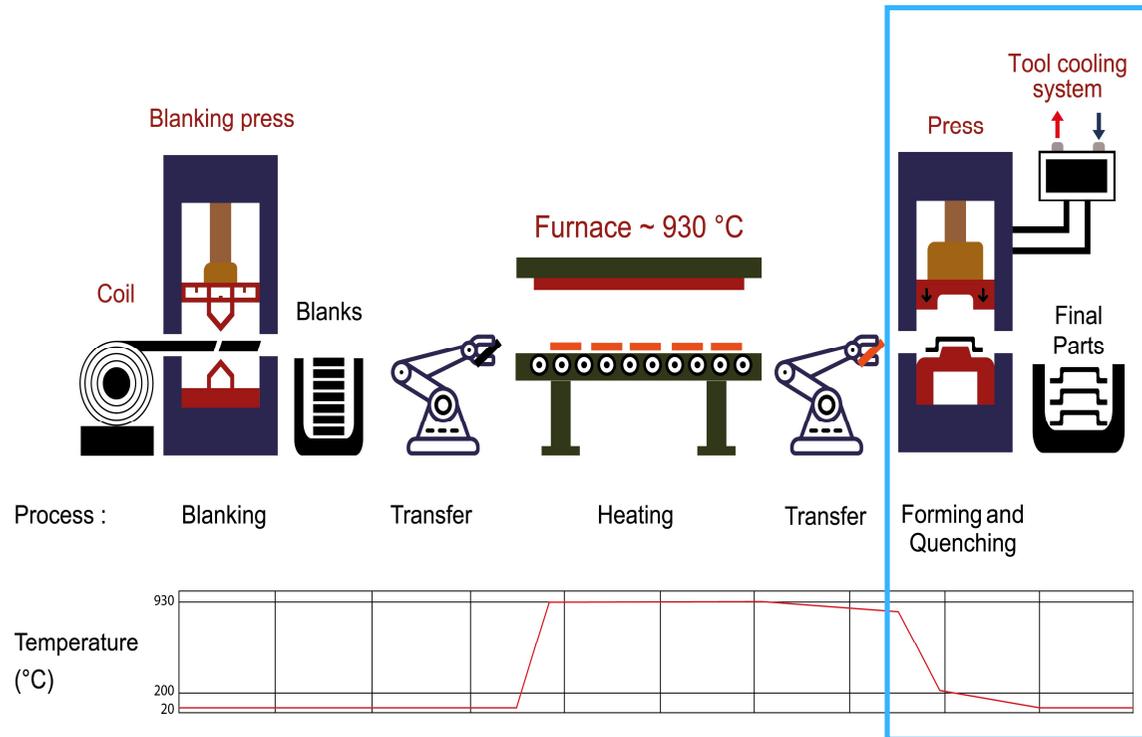


# IMPROVING HIGH TEMPERATURE PROPERTIES

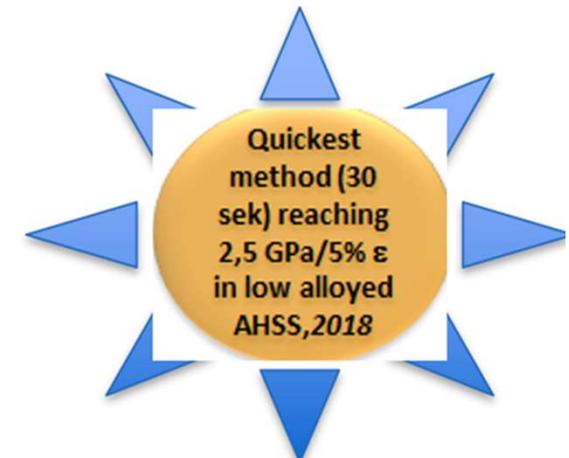
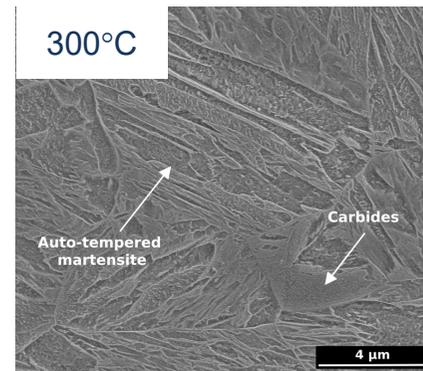
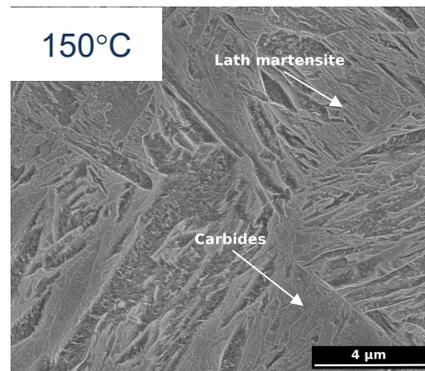
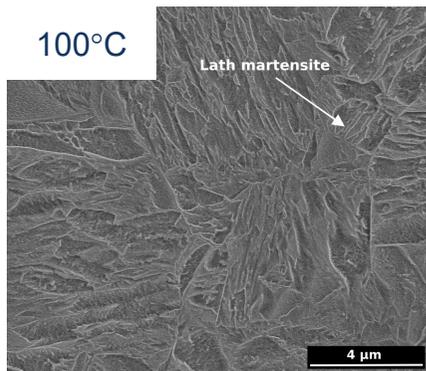


# MANUFACTURING INFLUENCES MICROSTRUCTURE

## THERMOMECHANICAL PROCESSING – PRESS HARDENING



# HEAT TREATMENT INFLUENCES MICROSTRUCTURE



# ULTRASONIC TREATMENT



Exploration

Mining

Mineral processing

Metallurgy

Metal manufacturing

Acoustic softening

**Metals forming**

- Extrusion
- Wire drawing
- Rolling

**Metals welding**

- Friction stir welding
- Additive manufacturing

**Surface treatment**

- Fatigue resistance
- Wear resistance

**Bulk treatment**

- Stress relaxation
- Ductility

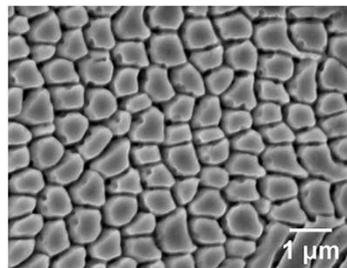
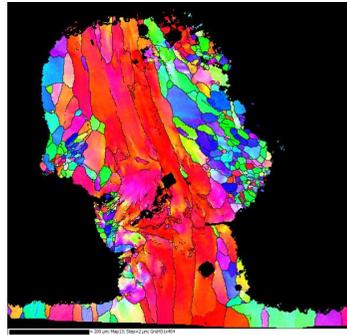
Improvement of mechanical properties

10<sup>7</sup> times lower energy use!

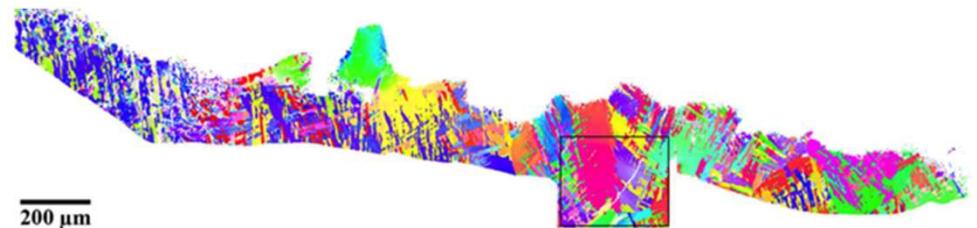
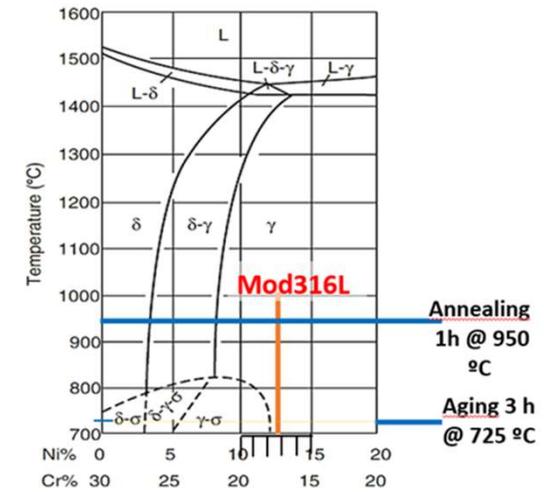
# ADDITIVE MANUFACTURING

Challenges:

- Anisotropy and texture
- New microstructural features
- Alloy development
- Fatigue properties



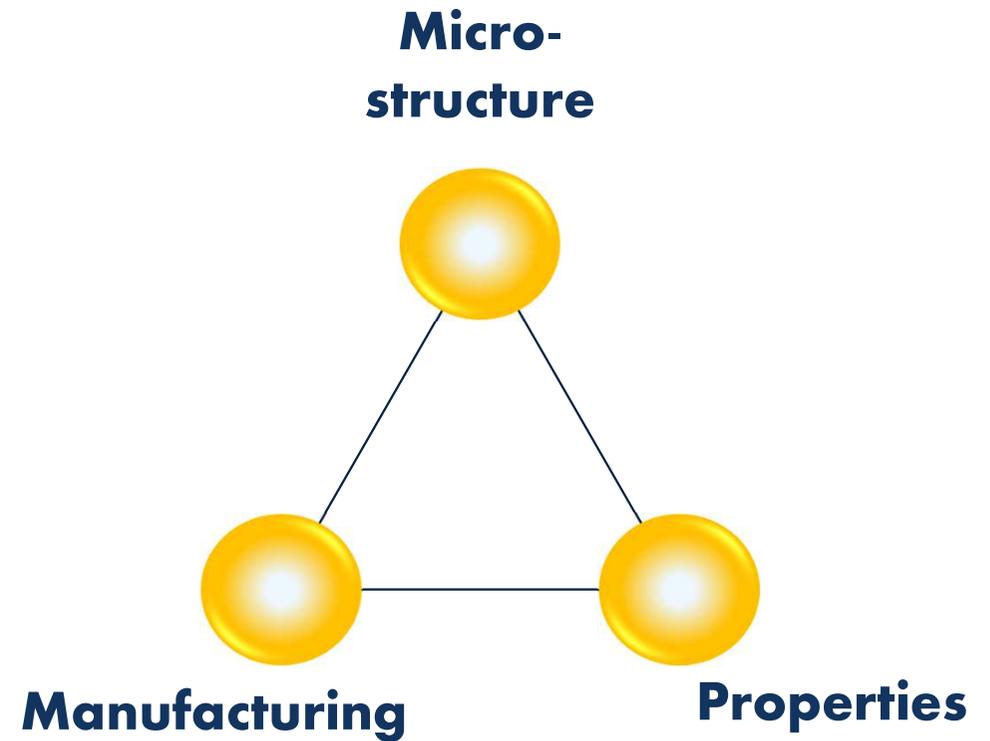
Element	N	Nb	W	Si	Mn	Cr	Ni	Mo	Cu	C	Fe
Wt%	0.006	0.4	2.13	0.38	0.6	17.0	12.6	0.8	2.51	0.07	Bal.



# OUTLOOK

- New processing methods
- New alloys

Still a lot to explore!



*THANK YOU FOR  
YOUR ATTENTION!*



Emil Edin



Khalifa Maissara



Viktor Sandell



Patricio Piantanida



Raghuveer Gaddam



Pia Åkerfeldt



Birhan Sefer  
Magnus Neikter



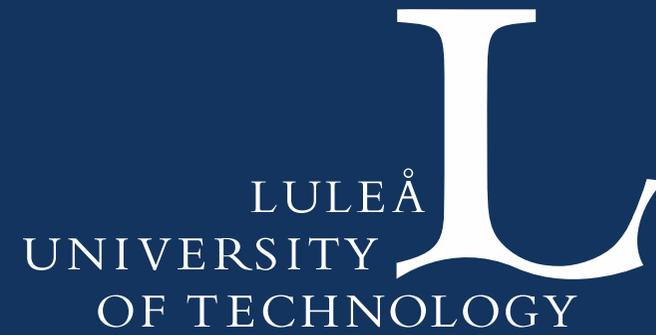
Farnoosh Forouzan



Erik Nilsson



Pragya Mishra



[marta-lena.antti@ltu.se](mailto:marta-lena.antti@ltu.se)