Mechanical Testing & Characterization of ZK60 Magnesium at Various Temperatures

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Research Significance

- Magnesium is about 2/3 as dense as aluminum
  - Often used for aircraft and automobiles
- Understanding when and how it fails is crucial to safe construction in these industries
- **Studying twinning in magnesium will help these industries develop safer and more efficient products**

Note: from *Witness the design and construction of and Airbus A350 aircraft* by Britannica, retrieved from https://cdn.britannica.com/98/185398-138-0F7FB00B/design-construction-aircraft-Airbus-A350.jpg?w=800&h=450&c=crop

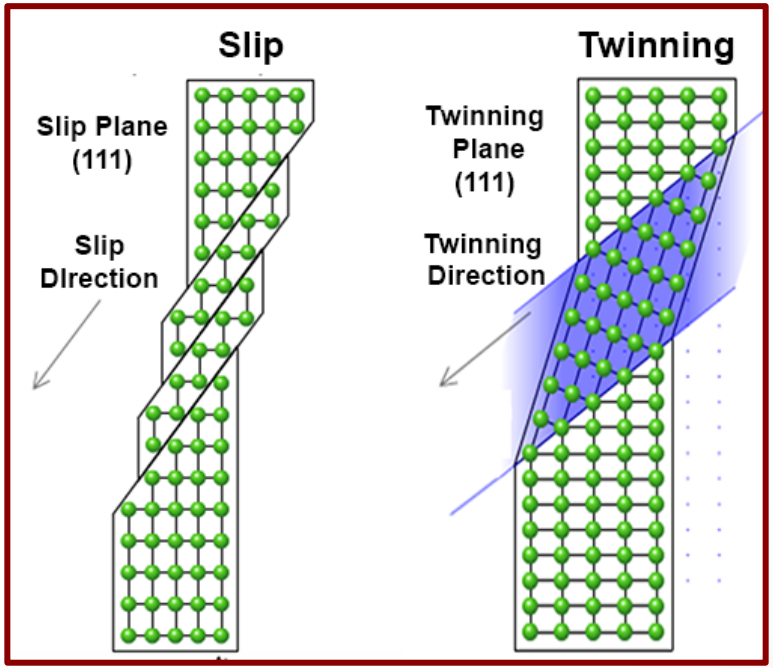
Design Experiments

Research Question

- How does temperature affect the frequency and manner of occurrence of twin surfaces in ZK60 magnesium under compressive stress?

Twinning Behavior in Magnesium

- Generally occurs when usual deformation mechanism (slipping) is inhibited
- More readily under high strain rate



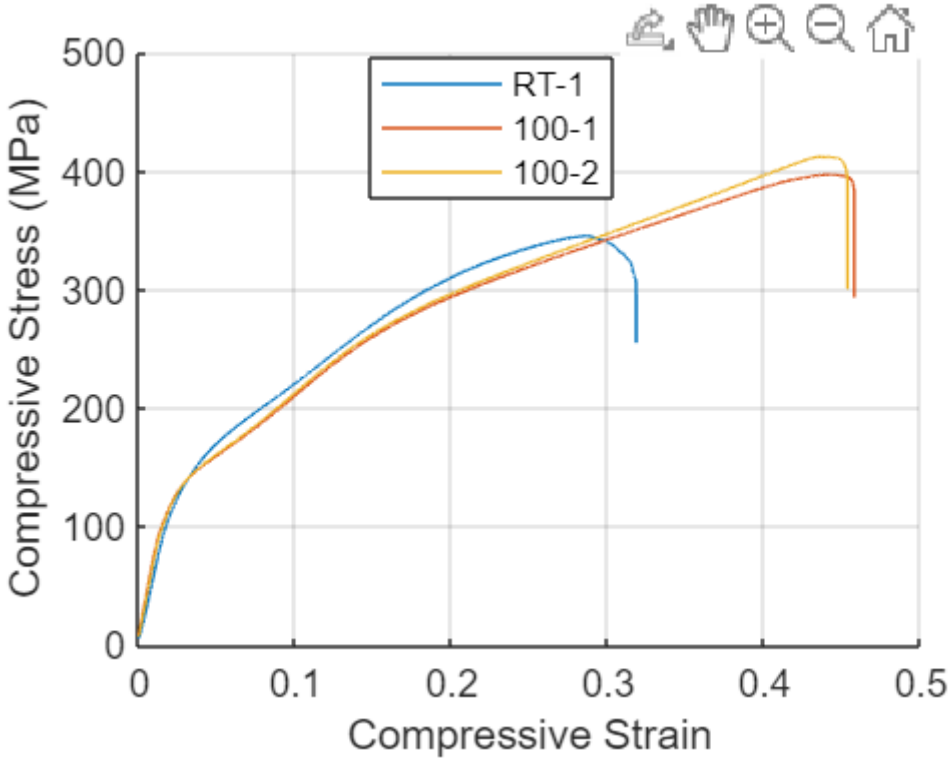
Note: From *Unexpected Twins* by Neil K. Bourne, 2016, retrieved from https://physics.aps.org/assets/e0691a5d-d656-4be3-b1cf-f73fdac9ad75/e19_3_medium.png

Experimental Procedure

1. Heat furnace to desired temperature
2. Measure all dimensions of specimen with micrometer
3. Run test until 40% strain or failure
4. Repeat for each sample

Experimental Results

Stress-Strain Curves



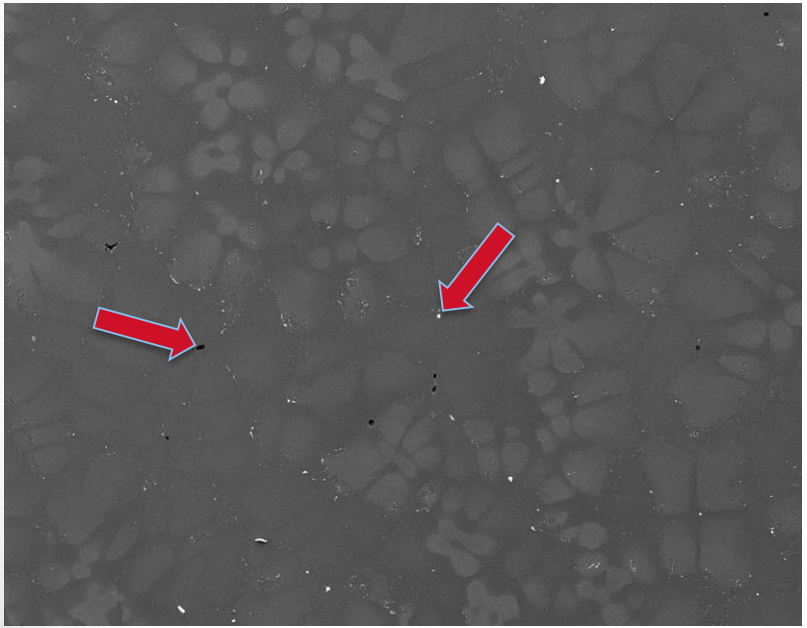
Experimental Material Properties

Property	Temp (°C)	Avg. Value (MPa)
Yield Strength	19	
	100	
	200	
Ultimate Compressive Strength	19	
	100	
	200	

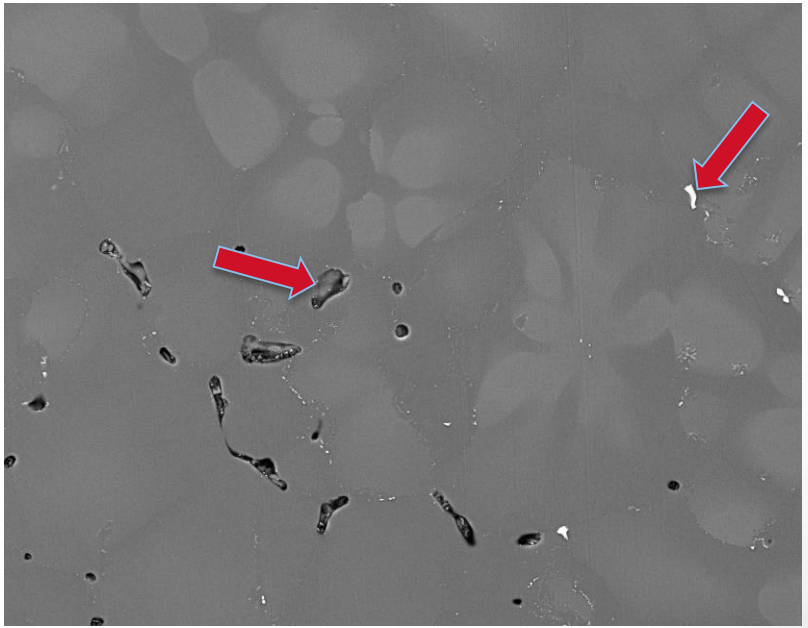
Microstructure Investigation

Grain Size

SEM Magnification 1

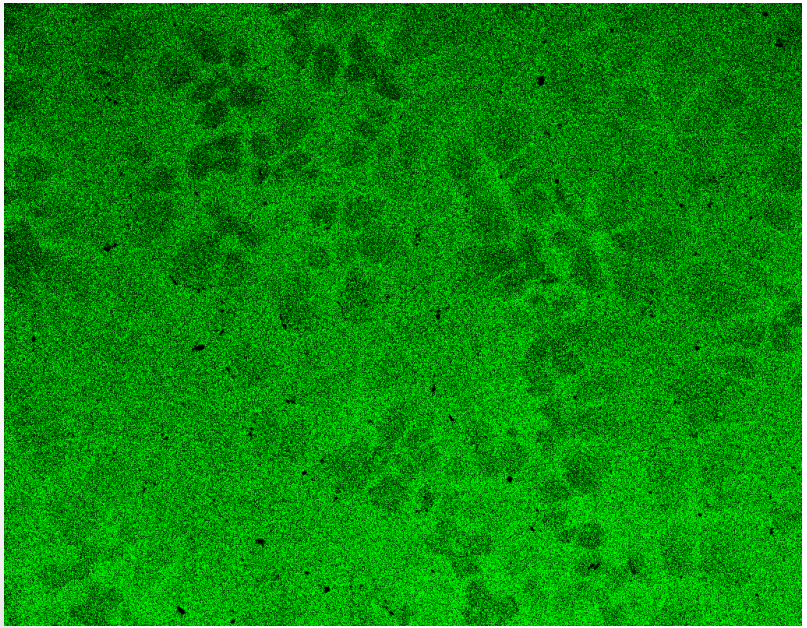


SEM Magnification 2

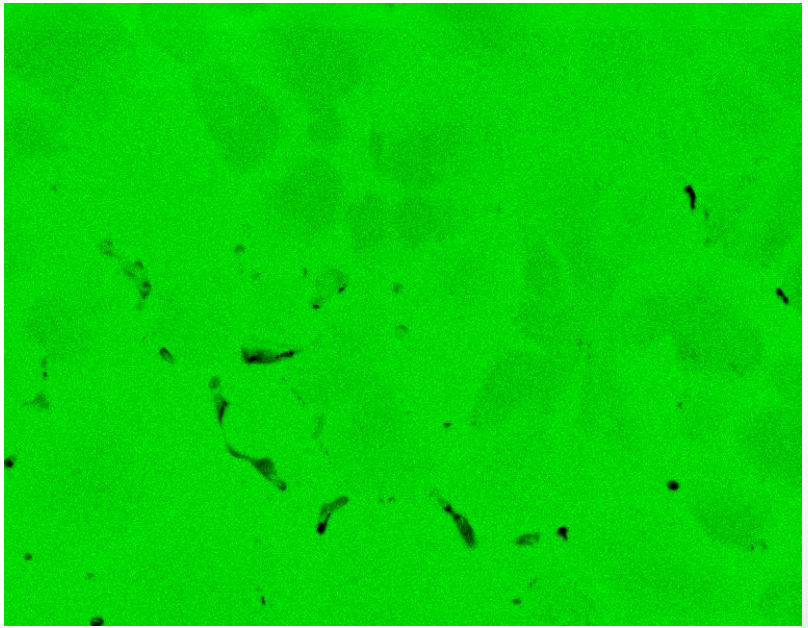


Magnesium Content

SEM Magnification 1

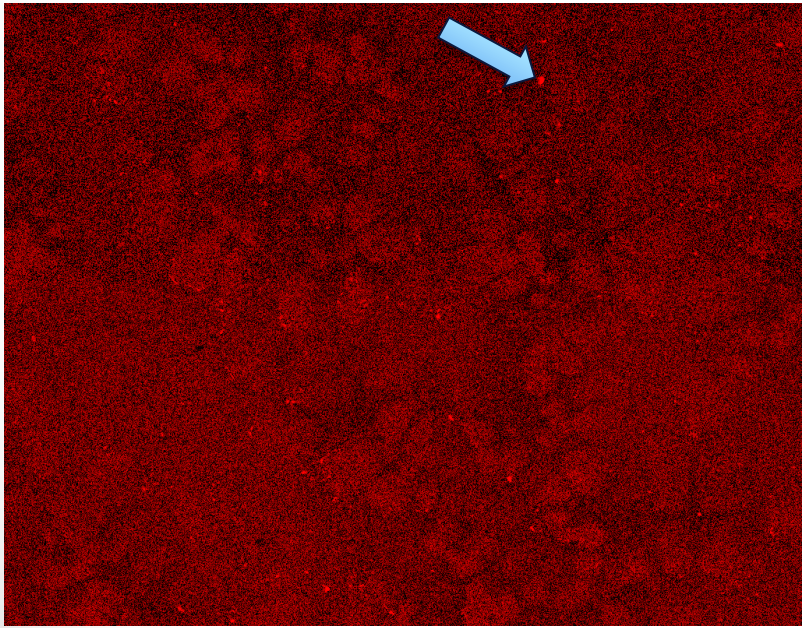


SEM Magnification 2

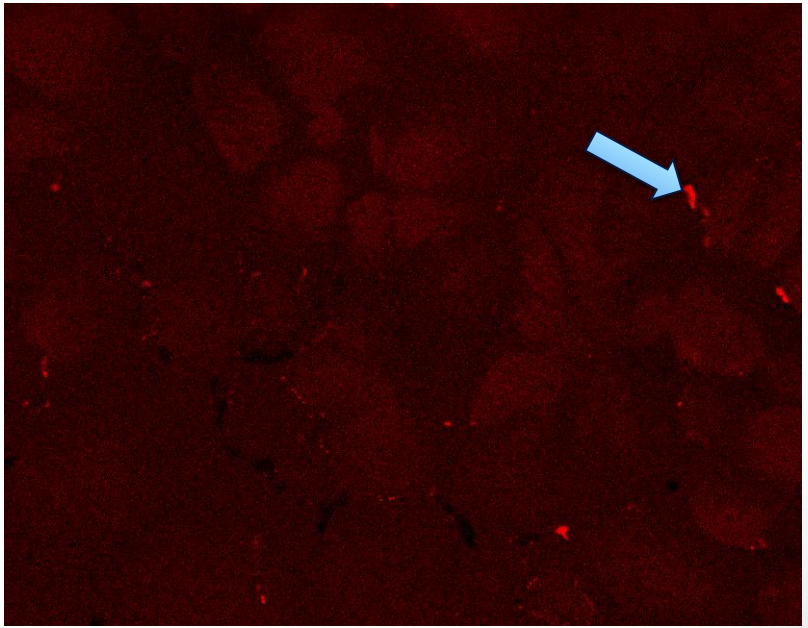


Zinc Content

SEM Magnification 1

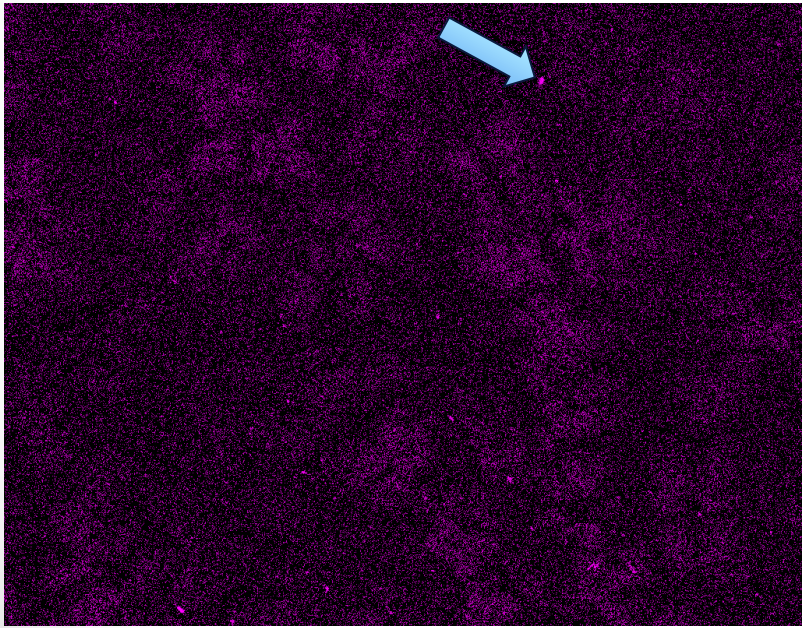


SEM Magnification 2

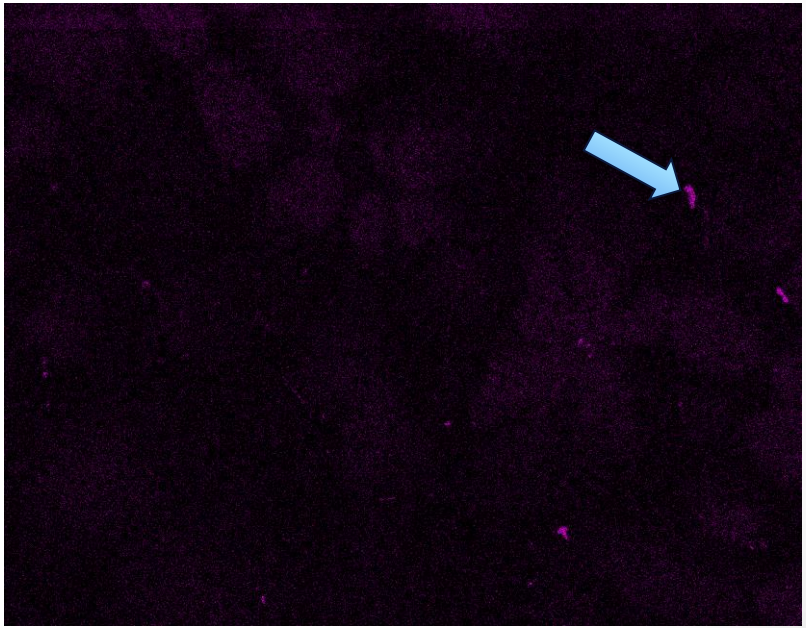


Zirconium Content

SEM Magnification 1



SEM Magnification 2



Microstructure Investigation (cont.)

(observations/conclusions from previous slides)

Analysis

(summary of findings and answer to research question)

Conclusion

(how findings affect real-world applications of magnesium)

References

- Bourne, N. K. (2016). Unexpected twins, *Physics Magazine, 9*(19), https://physics.aps.org/articles/v9/19
- Magnesium. (2024). *Royal Society of Chemistry*, https://www.rsc.org/periodic-table/element/12/magnesium
- Unexpected twins. [Image]. (n.d.) Retrieved from https://physics.aps.org/assets/e0691a5d-d656-4be3-b1cf-f73fdac9ad75/e19_3_medium.png
- Witness the design and construction of and Airbus A350 aircraft. [Image]. (n.d.) Retrieved from https://cdn.britannica.com/98/185398-138-0F7FB00B/design-construction-aircraft-Airbus-A350.jpg?w=800&h=450&c=crop