Influence of Magnesium on the Microstructure and Mechanical Behaviour of Recycled Al-Si Alloys

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MDPI

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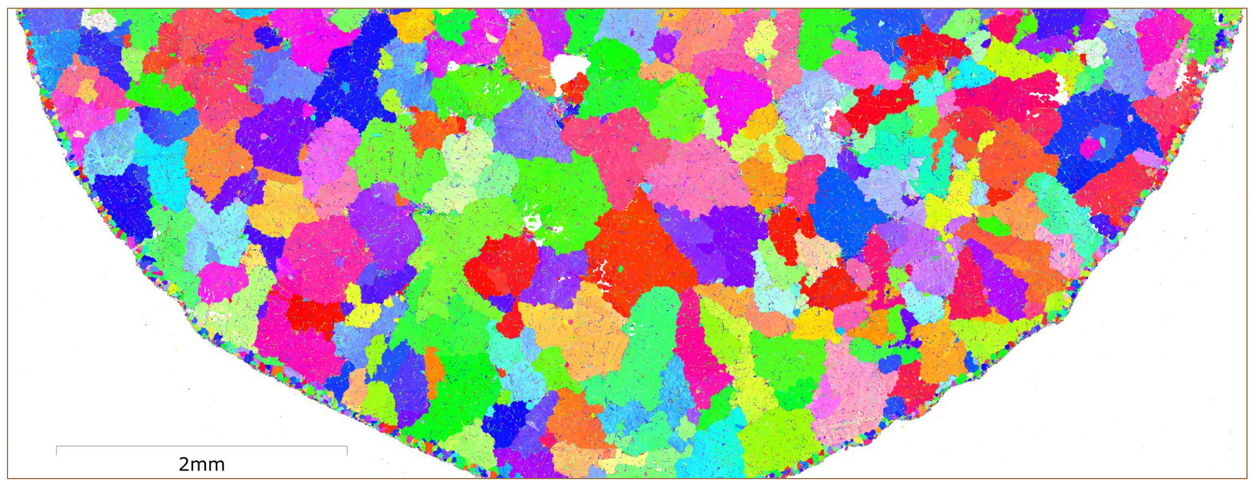
BACKGROUND

- Recycled Al–Si alloys provide **sustainability** benefits but face challenges during recycling, such as:
  - Fe contamination
  - Maintaining alloying element balance (Si, Mg, Ni, Zn, Pb)
- Fe impurities promotes Fe-rich intermetallic phases that degrades mechanical properties
- Magnesium is commonly added to improve strength [1]
- Influence of Mg on microstructural and mechanical changes in **recycled** Al–Si alloys needs further study

RESULTS

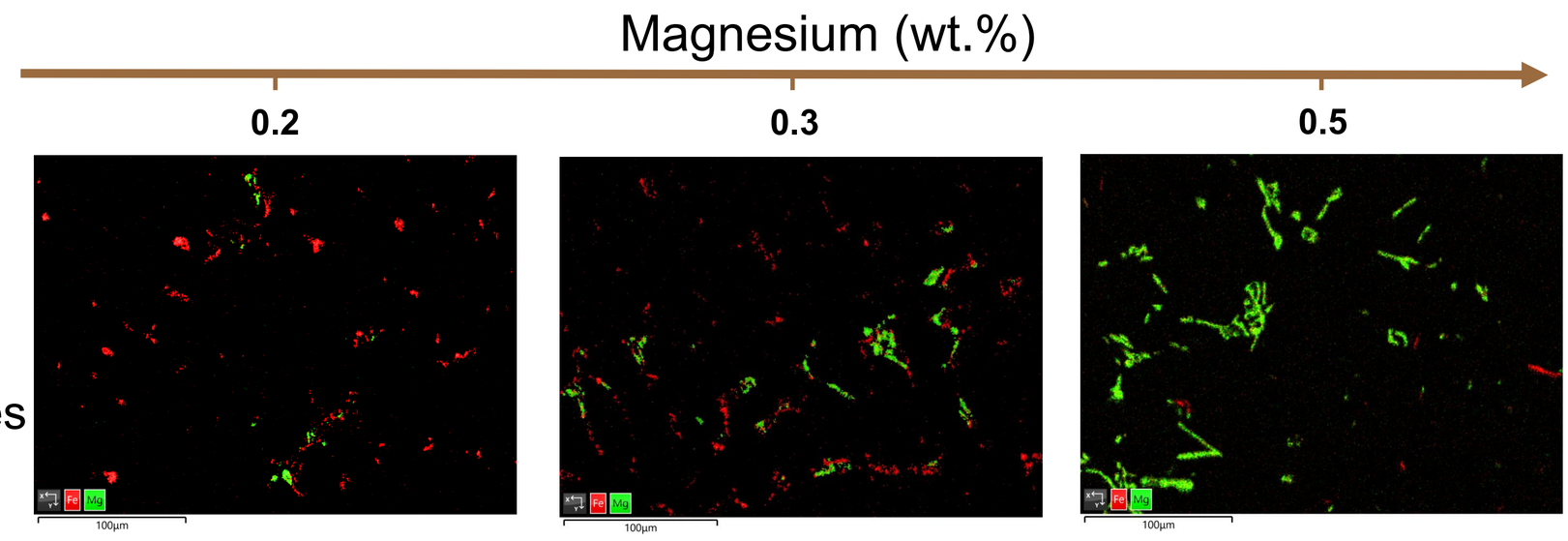
❑ Microstructure

No significant change with Mg additions (0.2-0.5 wt.%) in:
- Primary Al grain size
- Eutectic Si
- Secondary dendritic arm spacing



Intermetallics evolution

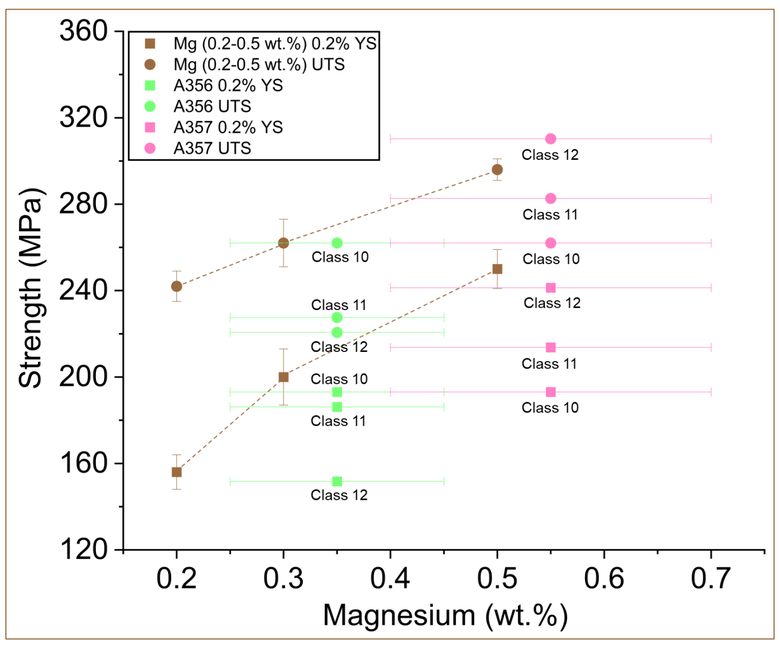
- Common intermetallics (IM's) identified: Al_5FeSi and $Al_8FeMg_3Si_6$
- With Mg addition:
  - Intermetallics volume fraction increases
  - Intermetallics exhibit growth in size
  - The fraction of Fe–Mg IM's increases relative to Fe-rich IM's

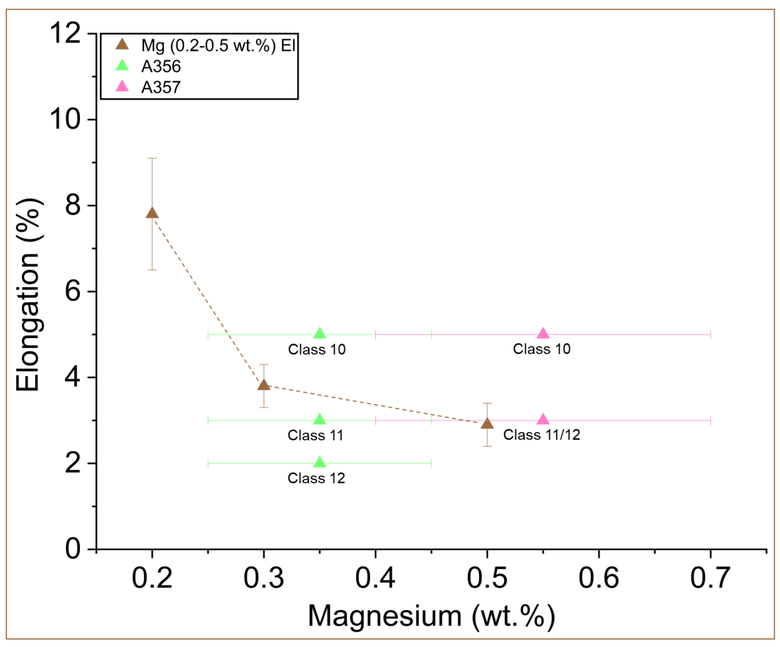


❑ Mechanical properties

Increasing Mg levels:
- Increased strength through precipitation and solid solution strengthening [2]
- Reduced ductility due to large IM's size

Recycled Al-Si alloy with Mg addition 0.3 and 0.5 wt.% : Comparable to *Aerospace Class 10* (A356) and *Class 12* (A357) [3] respectively





CONCLUSIONS

- Addition of Mg increases intermetallic size and volume impacting mechanical properties
- Increasing Mg (0.2 - 0.5 wt.%) significantly enhances strength but reduces ductility
- Recycled Al-Si alloys can achieve aerospace-grade performance with optimal Mg

References

[1] A. Meshraf., World of metallurgy, 2021

[2] L. Ren.et.al., Materials, 12(24):4160, 2019

[3] AMS-A-21180C: Aluminum-Alloy Castings, High Strength. SAE, 2017

Acknowledgments

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