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Influence of T8 Heat Treatment on the Tensile Strength of Horizontally Solidified Al 6xxx Alloy Processed via a Thermomechanical Route for Conductive Wires

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Introduction

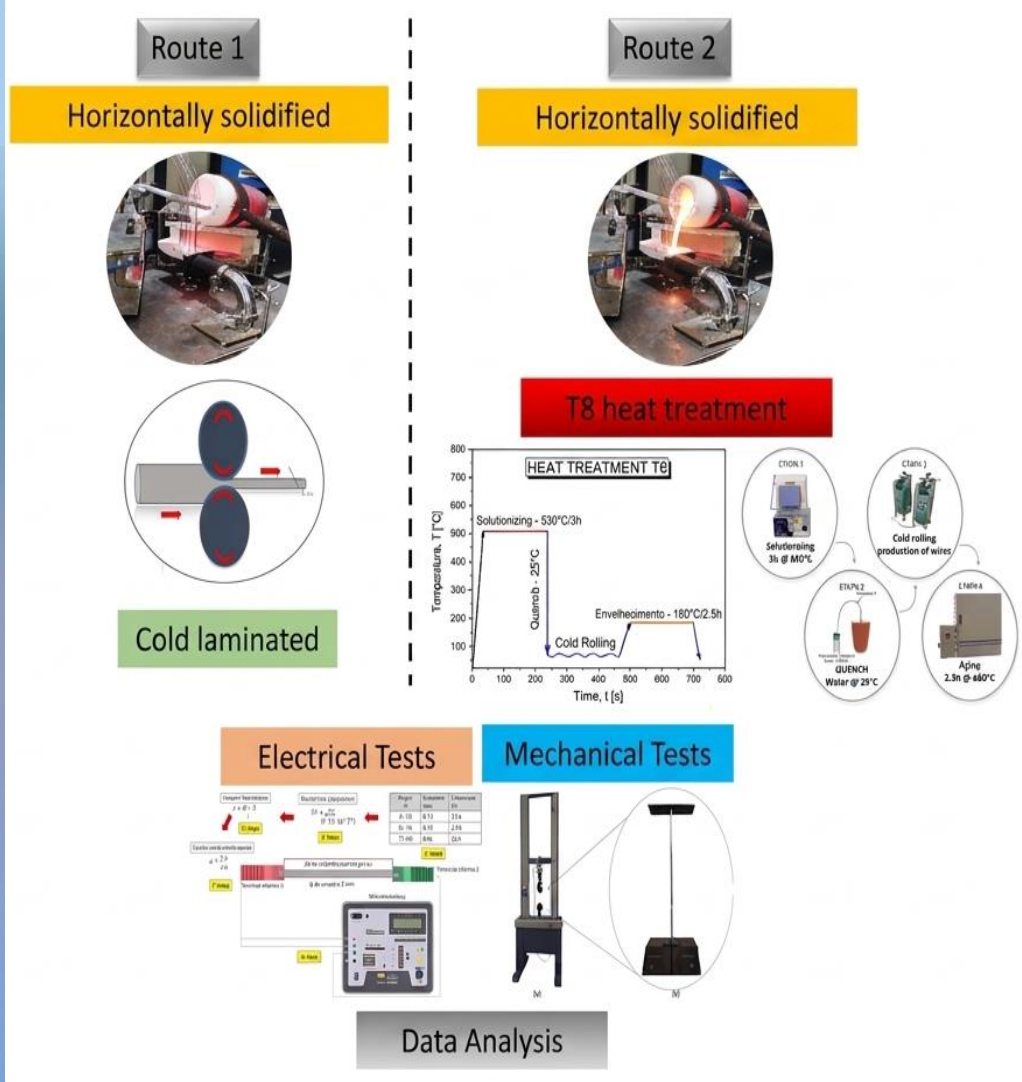
Al–Mg–Si alloys (6xxx series) are widely used in electrical conductors due to their combination of mechanical strength, electrical conductivity, and low density. Thermomechanical processing and precipitation hardening can improve their mechanical performance (Smyrak et al., 2020; Khangholi et al., 2021). However, the effects of T8 treatment compared with cold rolling alone in horizontally solidified Al-6201 alloys remain insufficiently explored.

Objective

To evaluate the influence of T8 heat treatment on the ultimate tensile strength of horizontally solidified Al 6201 alloy wires, comparing the mechanical performance of cold-rolled and T8-treated conditions.

Methodology

The following flowchart demonstrates the steps for each route.



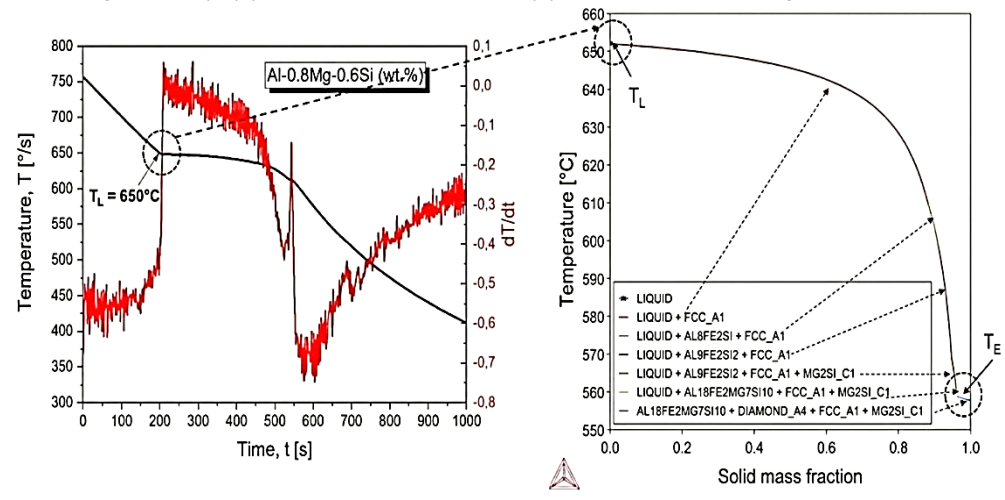
Route 1: Horizontal solidification followed by cold rolling.

Route 2 (T8): Horizontal solidification, solution treatment at 530 °C for 3 h, water quenching, cold rolling, and artificial aging at 180 °C for 2.5 h.

The T8 thermomechanical route followed approaches reported for Al–Mg–Si conductor alloys (Khangholi *et al*., 2022), with thermal parameters adopted from Marques (2025). Cold rolling was performed in 13 passes to obtain wires with a final diameter of 3.0 mm. Tensile tests were conducted to determine the ultimate tensile strength (UTS).

Results and Discussion

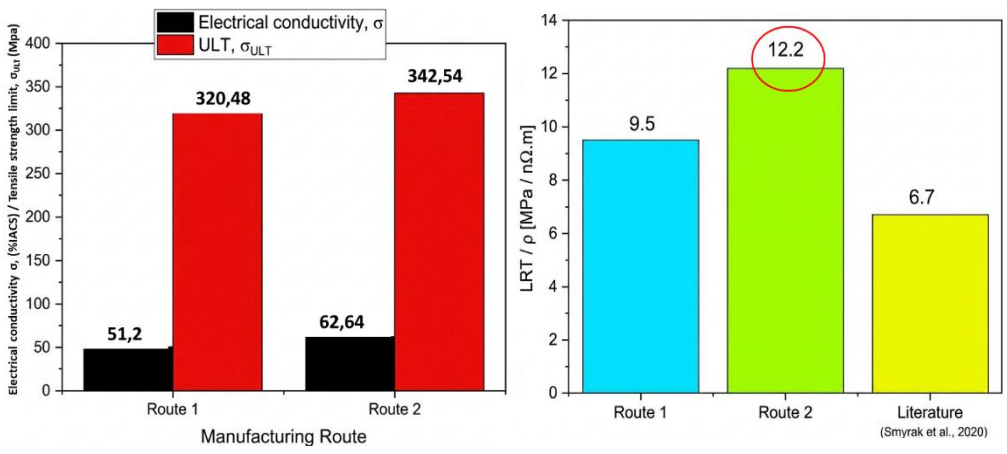
Figure 1. Experimental and theoretical thermal analysis of the solidification path of the investigated alloy: (a) experimental curve, and (b) curve simulated using Thermo-Calc.



(a) (b)

Figure 2. Comparative analysis of manufacturing routes: (1) solidification–cold rolling; and (2) solidification–T8 heat treatment.

Figure 3. Ultimate tensile strength-to-electrical resistivity ratio (UTS/ρ) for the investigated processing routes and the literature.



The T8 route exhibited higher ultimate tensile strength (342.54 MPa) and electrical conductivity (62.64% IACS) than cold rolling alone (320.48 MPa and 51.2% IACS). The UTS-to-resistivity ratio also increased from 9.5 to 12.2 MPa/(nΩ·m), indicating improved combined mechanical and electrical performance under the investigated processing conditions.

Conclusions

The T8 thermomechanical route increased the electrical conductivity of the Al-6201 alloy by 22.34%, reaching 62.64 ± 1.00% IACS, and improved tensile strength by 6.88% compared with cold rolling alone. These results demonstrate the potential of T8 processing to enhance the mechanical and electrical performance of Al-6201 conductive wires.

References and Acknowledgments

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