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Adjusting for barrelling during compression tests

Investigating the material behaviour of a 3D printed aluminium alloy

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Abstract

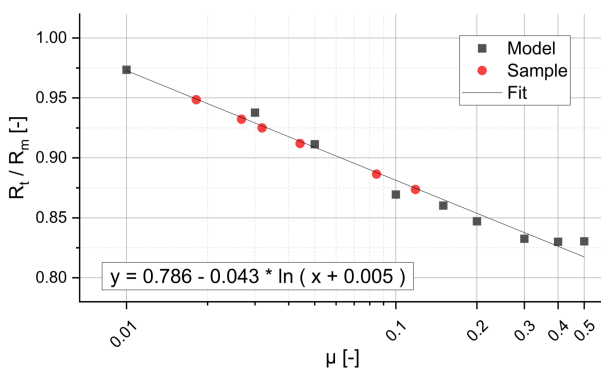
We study additively manufactured aluminium (A20X) sample deformation at room temperature across different strain rates using a Gleeble 3800. Force-displacement data are friction-corrected to derive flow curves and fit constitutive models. Validated Finite Element models, calibrated by post-deformation geometry, replicate the tests, integrating experiments and modeling to capture alloy behavior.

Material

A20X is a lightweight, strong aluminum (TiB2 strengthened) material made for 3D printing. It makes smooth, reliable parts, works with common machines, and is approved for use in demanding fields like aerospace, space, defense, and high-end automotive.

Friction testing

The shape of the specimens affects the results. There are simple compressive tests and ring upsetting tests; we used simple cylindrical samples to fit our equipment. Compressing the material shows how it behaves under strong forces when. We kept a defined deformation and varied different deformation speeds at room temperature.

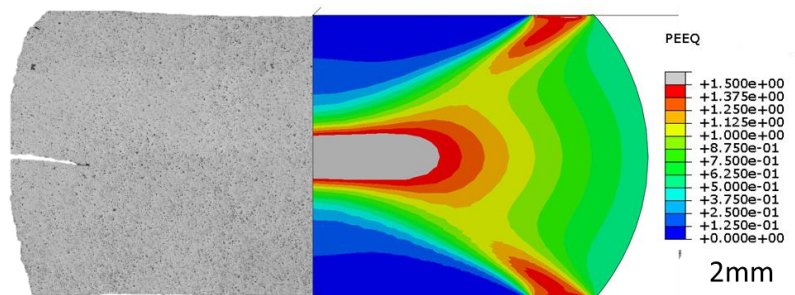


Mathematical correction and modelling

Friction can distort compression test results, so we prepare smooth, flat surfaces and add specific layers to reduce slipping and sticking. This improves contact, limits heat and force issues, and makes measurements more trustworthy. We then use the sample's before-and-after shape to correct the curves that describe how the material responds, giving a truer picture of its behavior.

Conclusions

- Applied a known barrelling correction; stresses became more realistic (lower).
- Linked sample shape to behavior; matches 2D model predictions.
- The Friction factor from the model agrees with measurements.
- Room-temperature model shows according strains to micrographs.



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Optional

- material testing
- additive manufacturing
- finite element modelling

