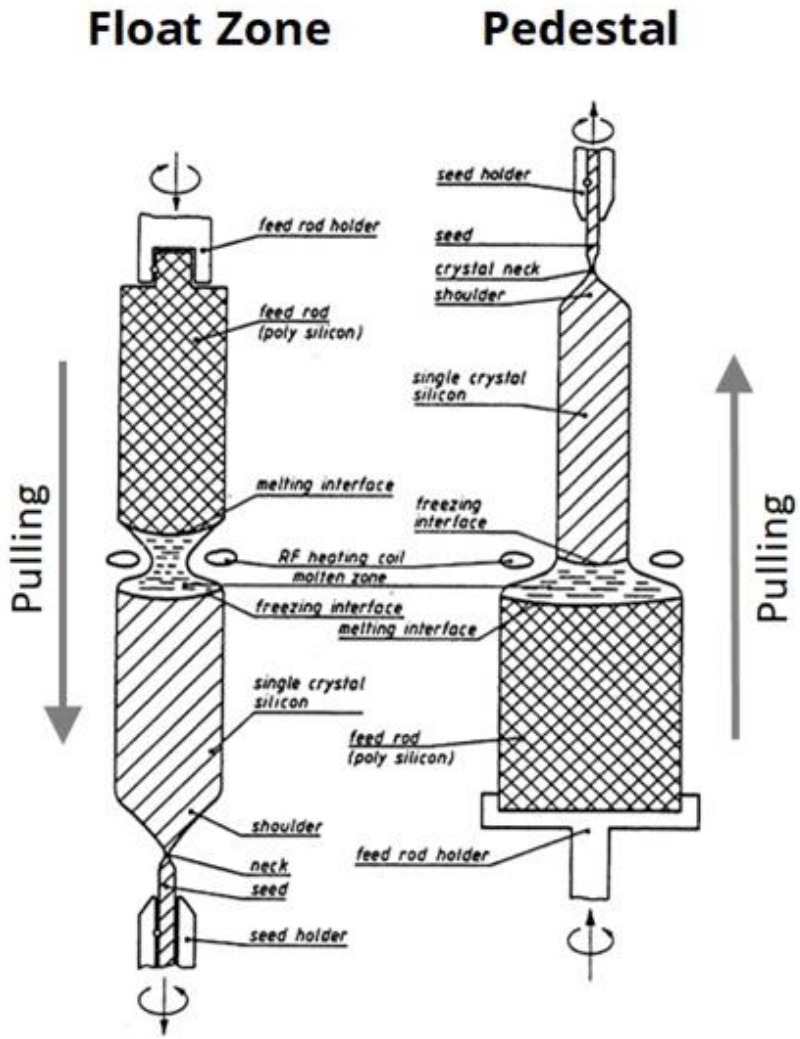
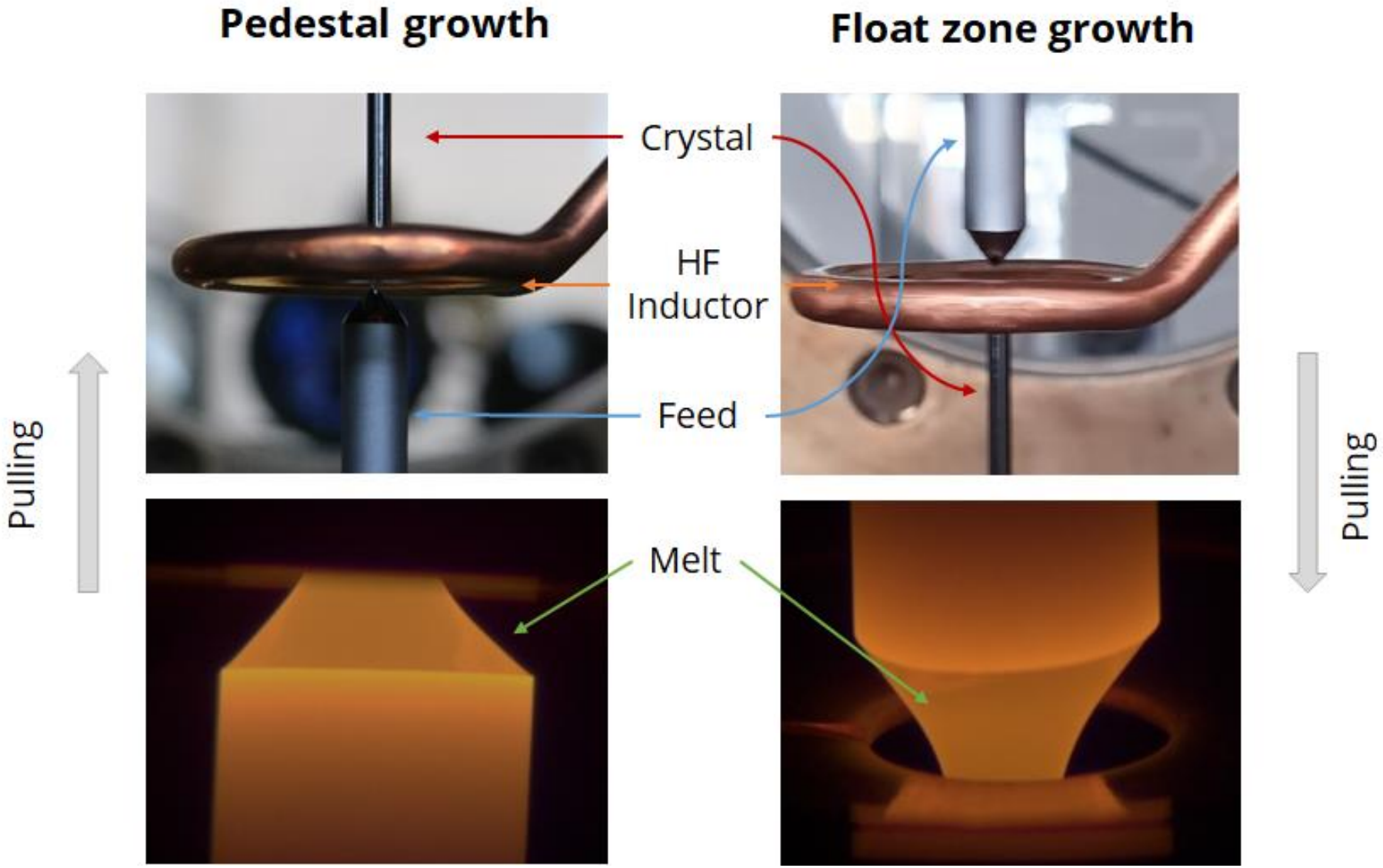
Silicon fibre growth

Crystal Growth Furnace
Steremat FZ1505



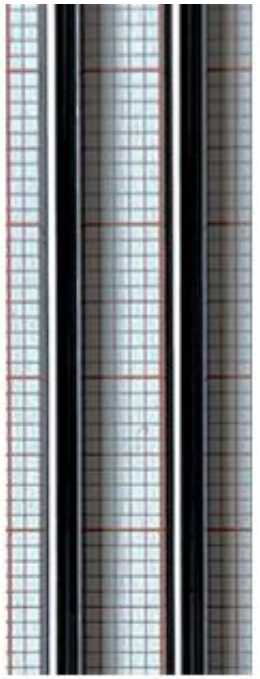
W. Zulehner. Mater. Sci. Eng. B 73 (2000)

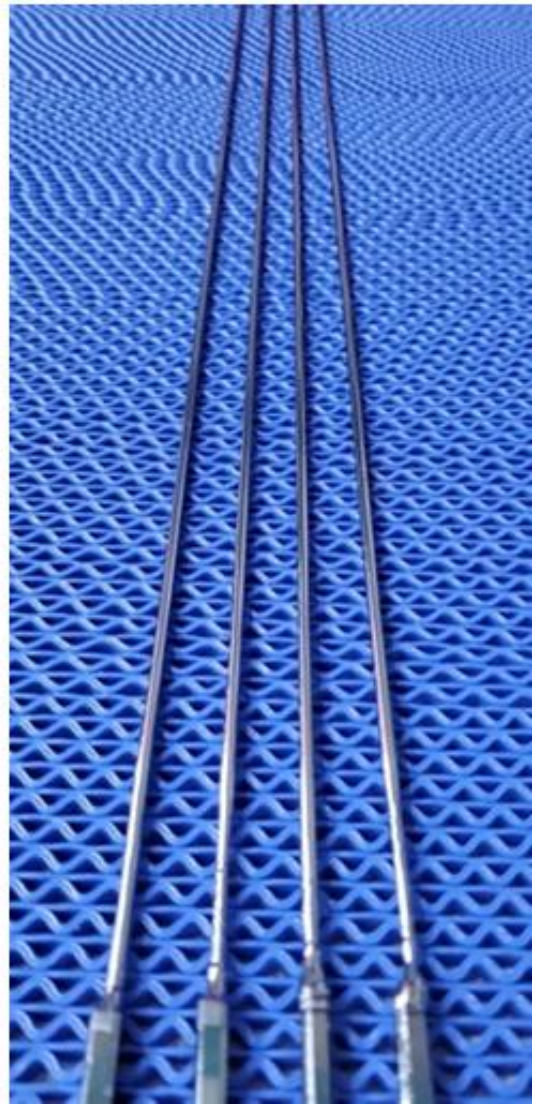
Silicon fibre growth

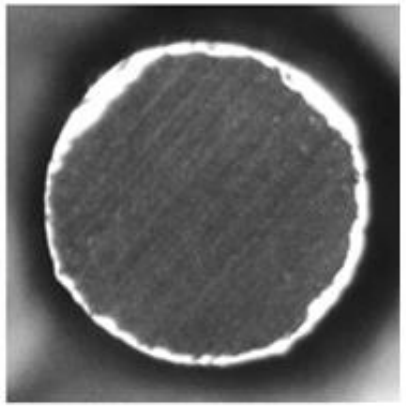


Final results on Si-fibre growth

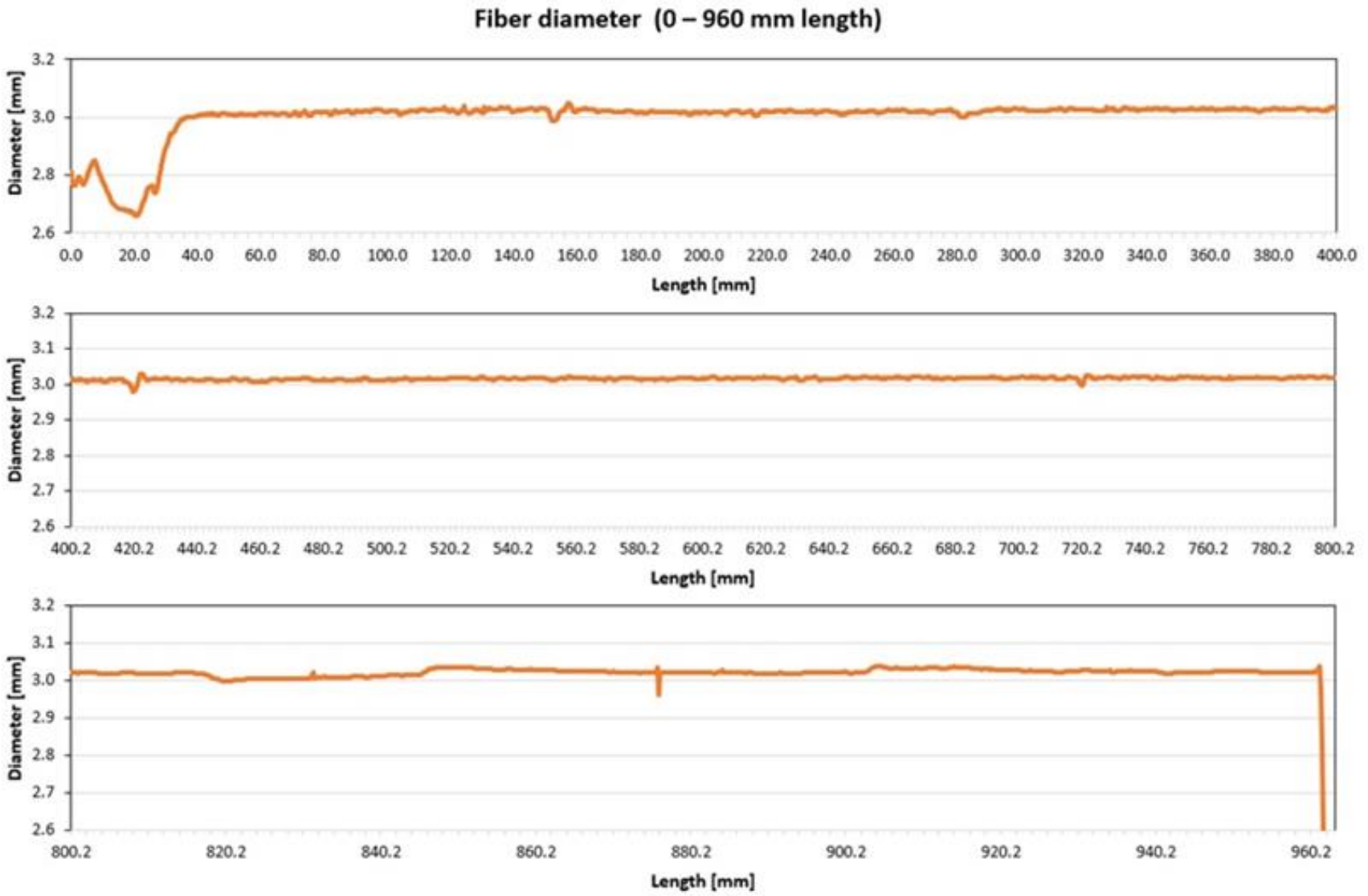
- Si-fibre diameter: 3 mm
- Diameter variation: +/- 0.1 mm
- Length: up to 1.5 m
- Reproducible process with low fibre-to-fibre variation
- Further development for stable and reproducible process for thinner fibre is required





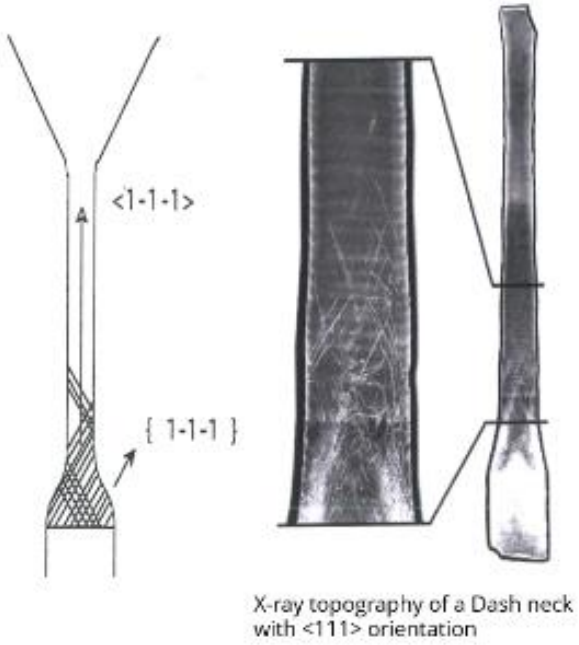


Final results on Si-fibre growth



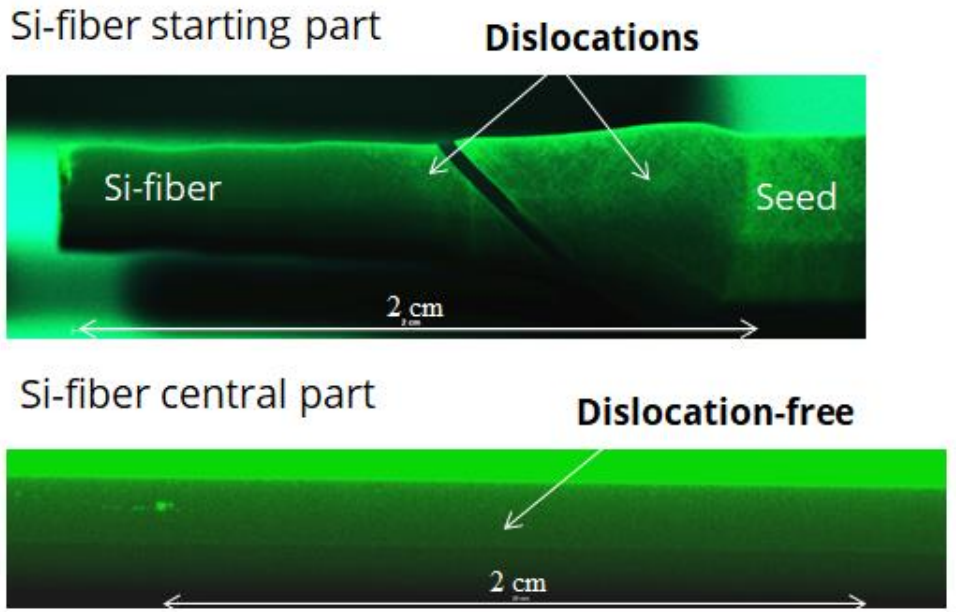
Measurement: S. Schneider

Defects and impurities in Si-fibre



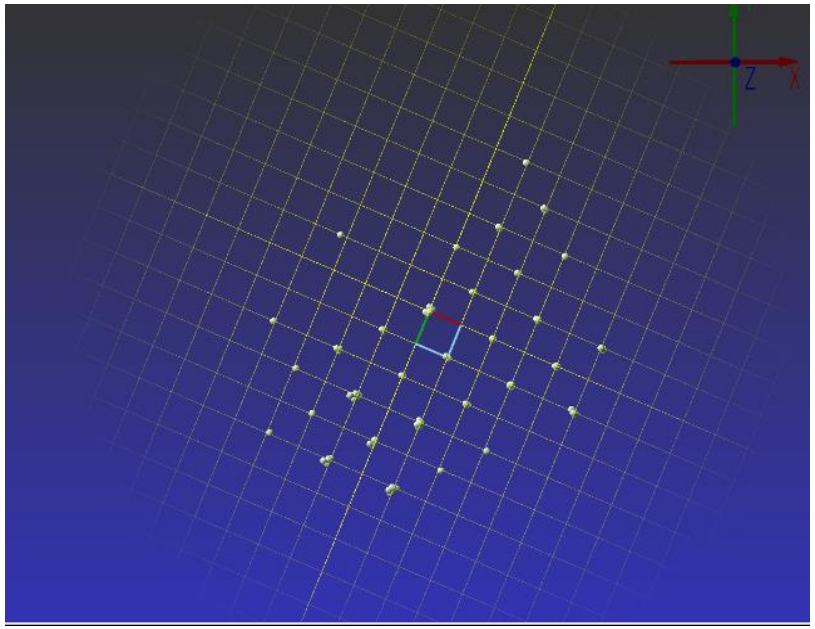
X-ray topography of a Dash neck with <111> orientation

Micro X-Ray Fluorescence (µ-XRF)



Measurement: C. Guguschev

XRD-measurements



Measured at Uni Glasgow

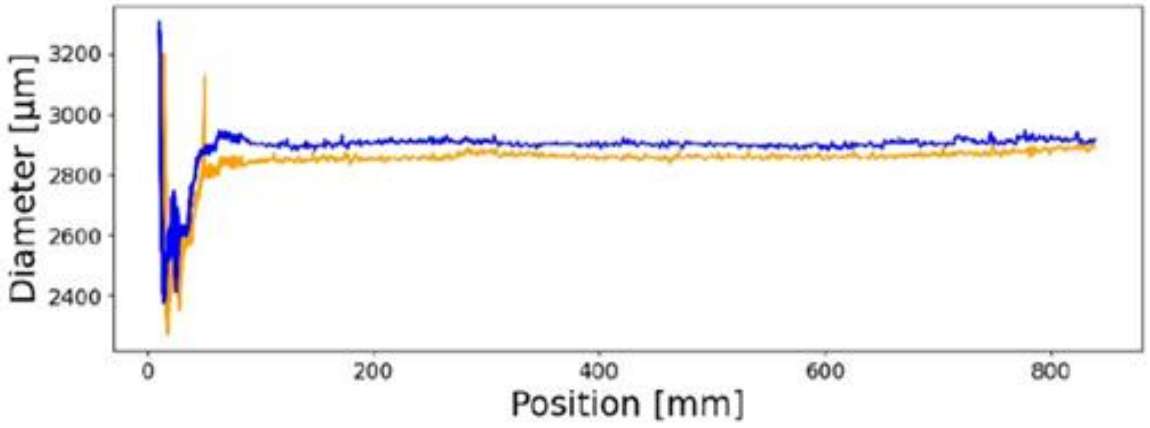
- Fibre growth is identical to Dash thin-neck technique
- Dislocations created during seeding due to thermal shock leave fibre after a few cm
- Growth technique ensures dislocation-free structure owing to low thermomechanical stress

- Oxygen and carbon are the most abundant impurities in silicon
- FTIR measurements confirm that O and C concentrations are below the detection limit (< 1016 cm3 for O and < 5·1015 cm3 for C)

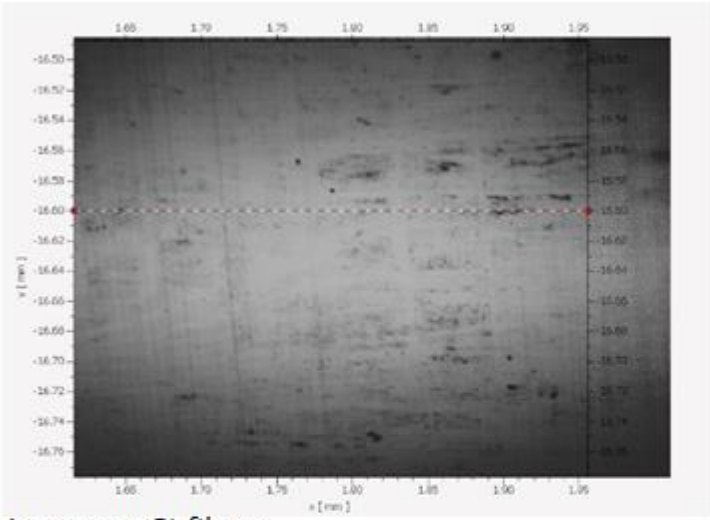
Surface quality of Si-fibres

- 11 fibres of length from 64cm to 116cm are currently being characterized at Glasgow
- Lowest diameter variation: 4.1%
- Surface quality overall good, with minor chips and indentations

Profile of the fibre

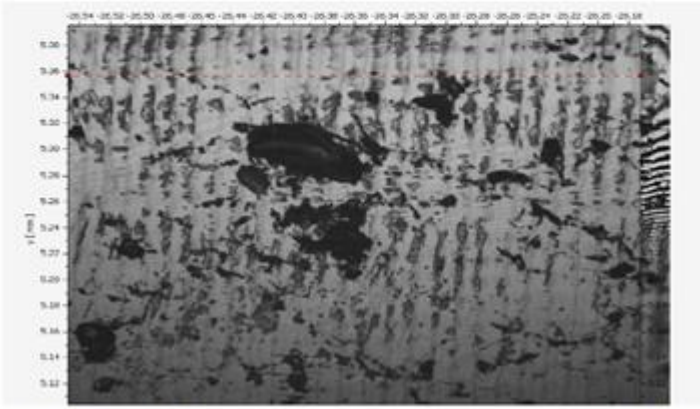


Close-up images taken on a Polytec microscope



As-grown Si-fiber

Manufactured by IKZ

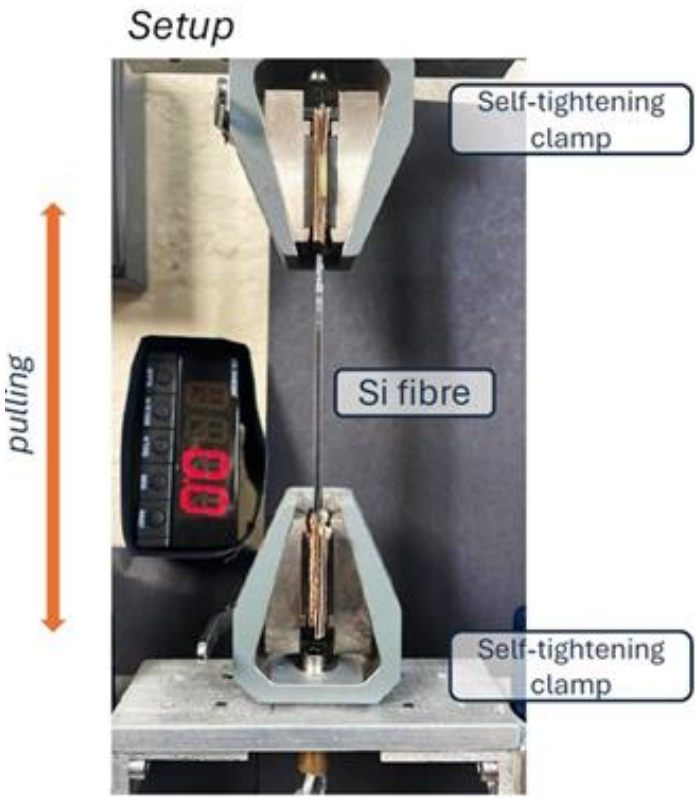


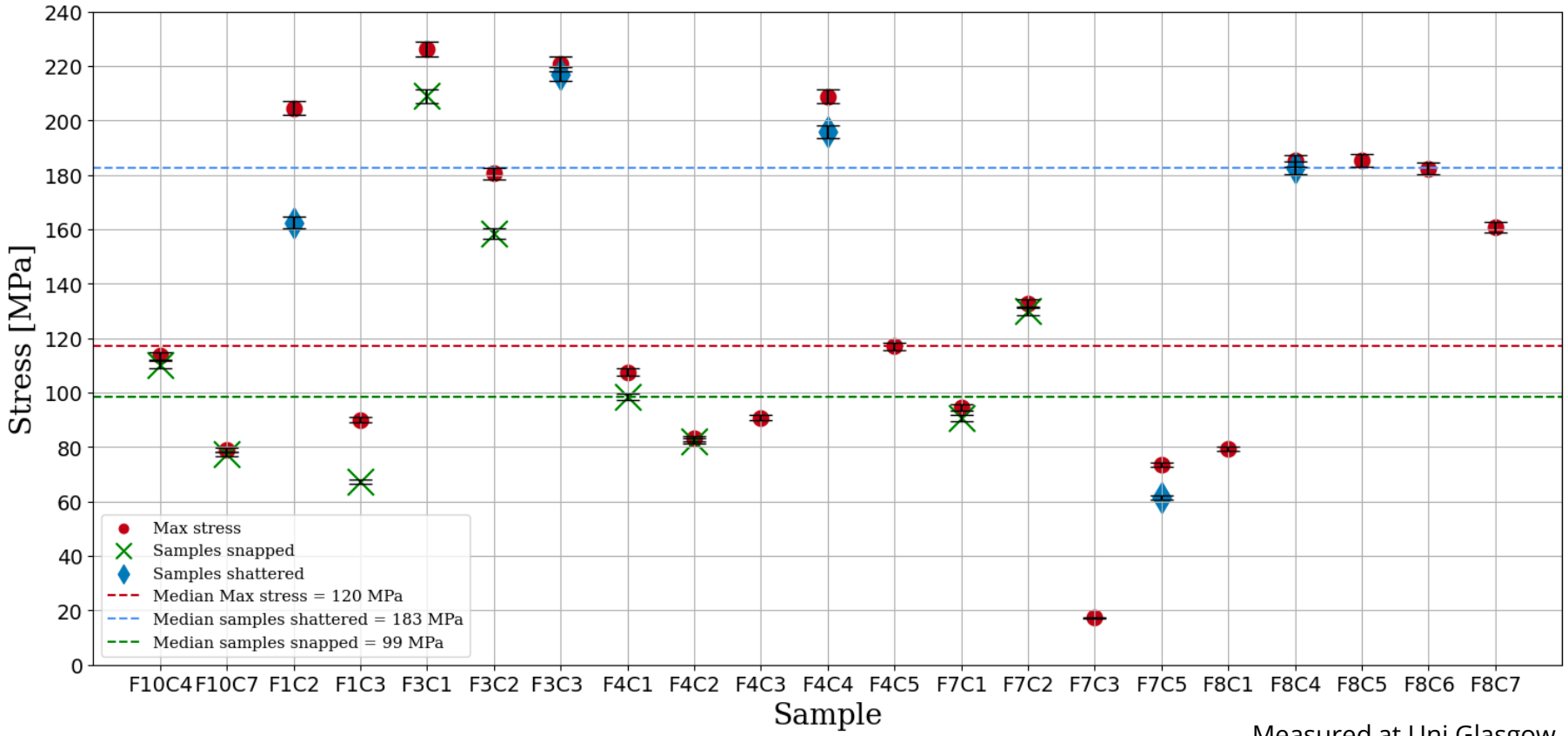
Ground S-fiber

Manufactured by Wielandts UPMT

Measured at Uni Glasgow

Mechanical strength of Si-fibres

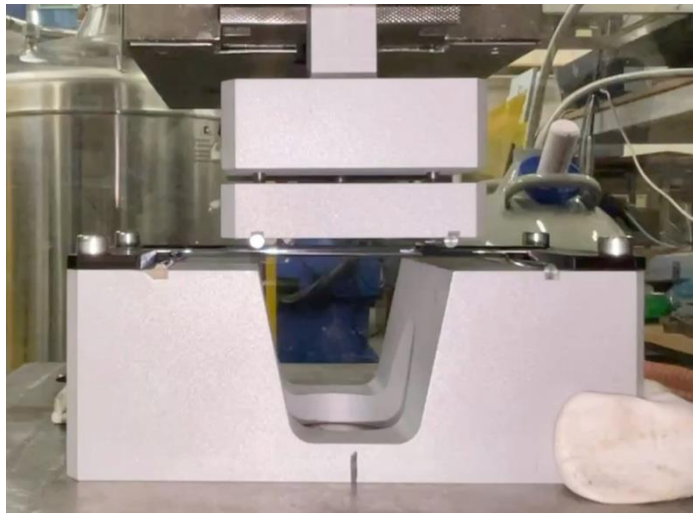




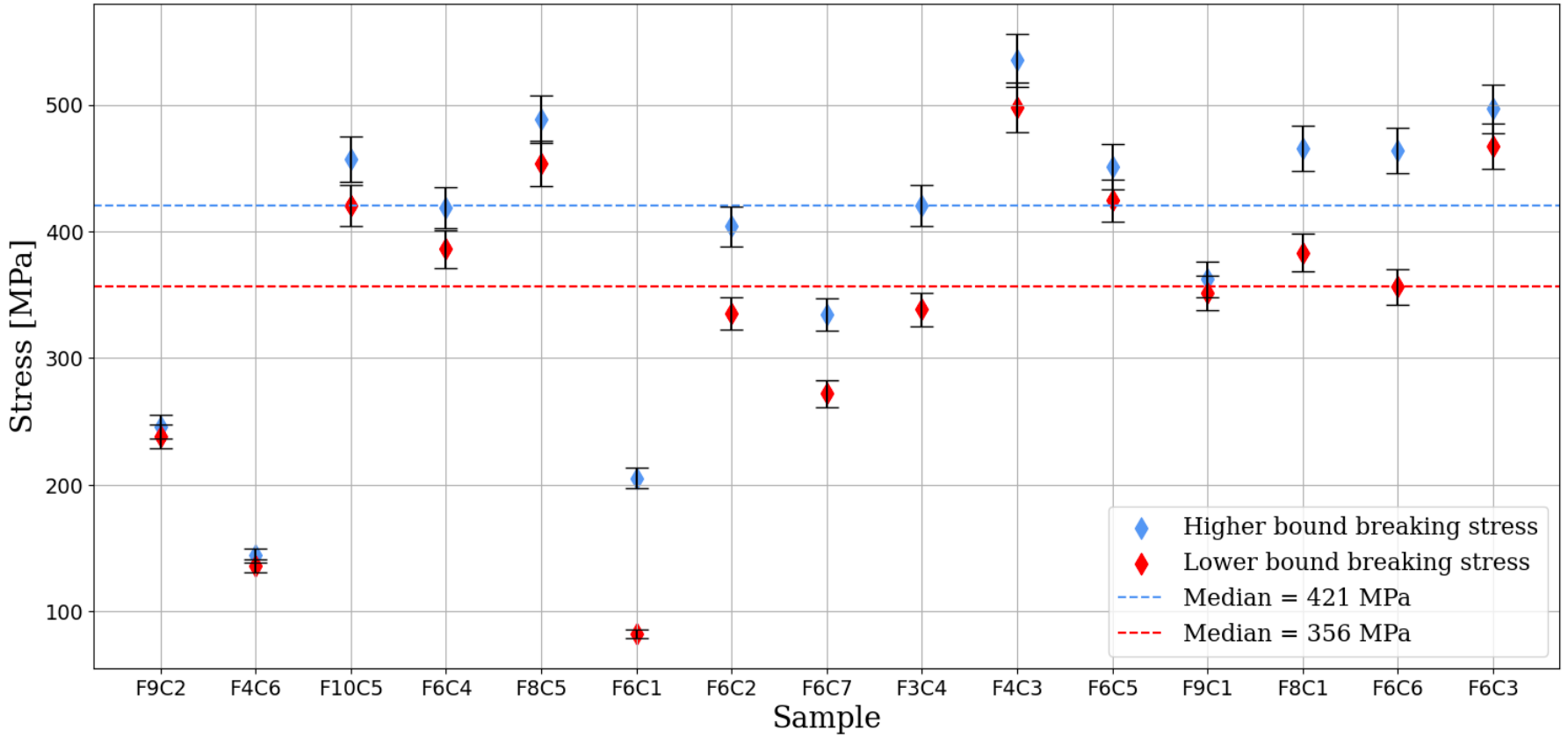
Measured at Uni Glasgow

Measured breaking stress is at lower limit due to alignment challenges

Mechanical strength of Si-fibres



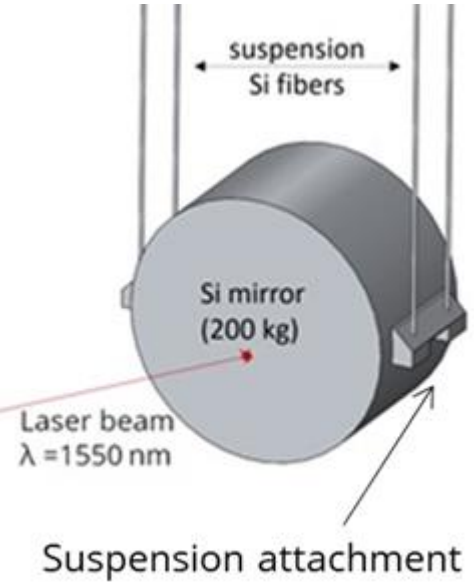
Better results at 4-point bending setup
(alignment is not an issue)



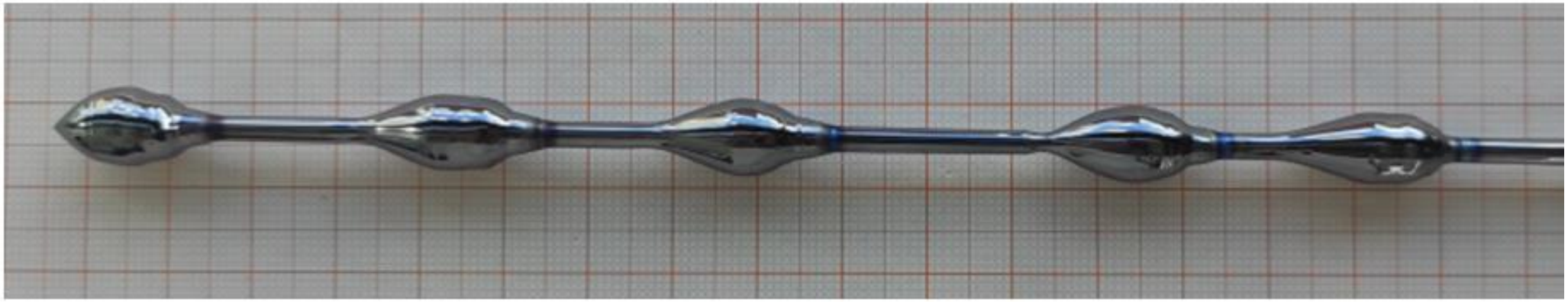
Measured at Uni Glasgow

Attachments of Si-fibres to mirror

- Enlarged fibre endings for further attachment
- Fibers with thicker endings (heads) grown within the same process
- Utilizing the same setup used for uniform fibre growth
- Reproducible size and shape

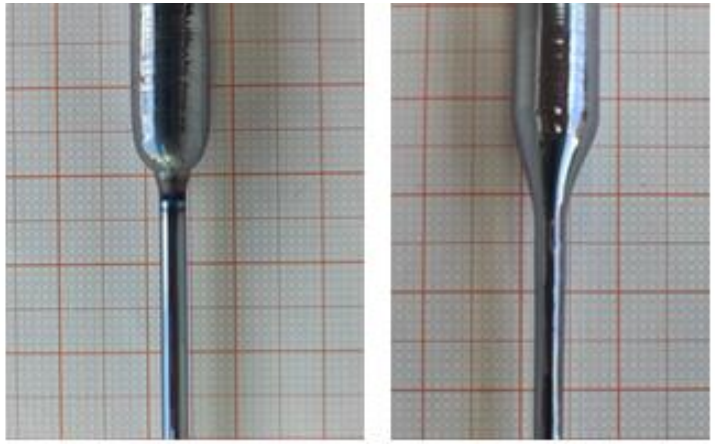


As-grown Si-fibers with tailored profile



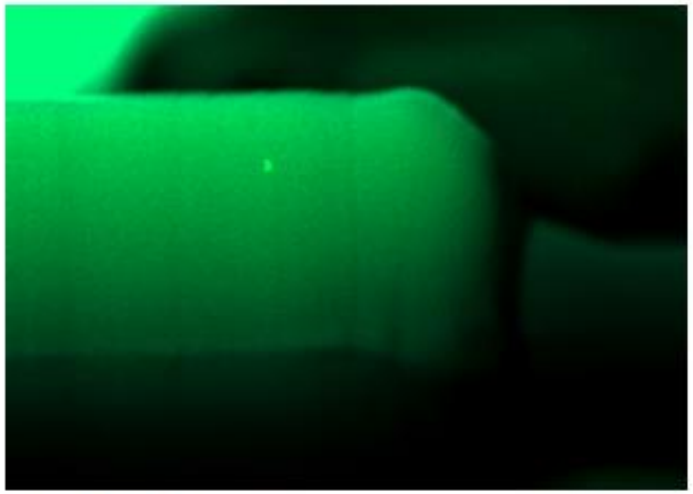
As-grown Si-fiber with nodes of different shapes

As-grown Si-fibres with heads



Ø 3 mm Si-fiber with Ø 8 mm heads

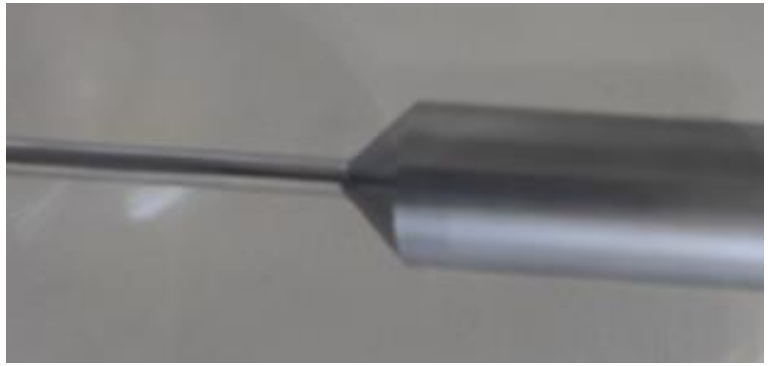
- Heads up to Ø 8 mm are achievable for Ø 3 mm Si-fibre
- Reproducible process for selected head shape
- No dislocation at transition part are found
- Samples are being investigated for mechanical strength
- Heads with larger Ø need further setup and process development



(µ-XRF)

Alternatively, recrystallisation of ground fibres with predefined shape

- Heads larger than Ø 8 mm partially regrown by FZ → recrystallized up to Ø 8 mm + ground from Ø 8 mm up to Ø 12 mm
- Recrystallization tests upcoming



Welding Si-fibres by FZ

FZ setup

Pedestal setup

- No restrictions for head Ø
- Irregular shape of welded part
- Low reproducibility as opposed to as-grown heads

Ø 8 mm head

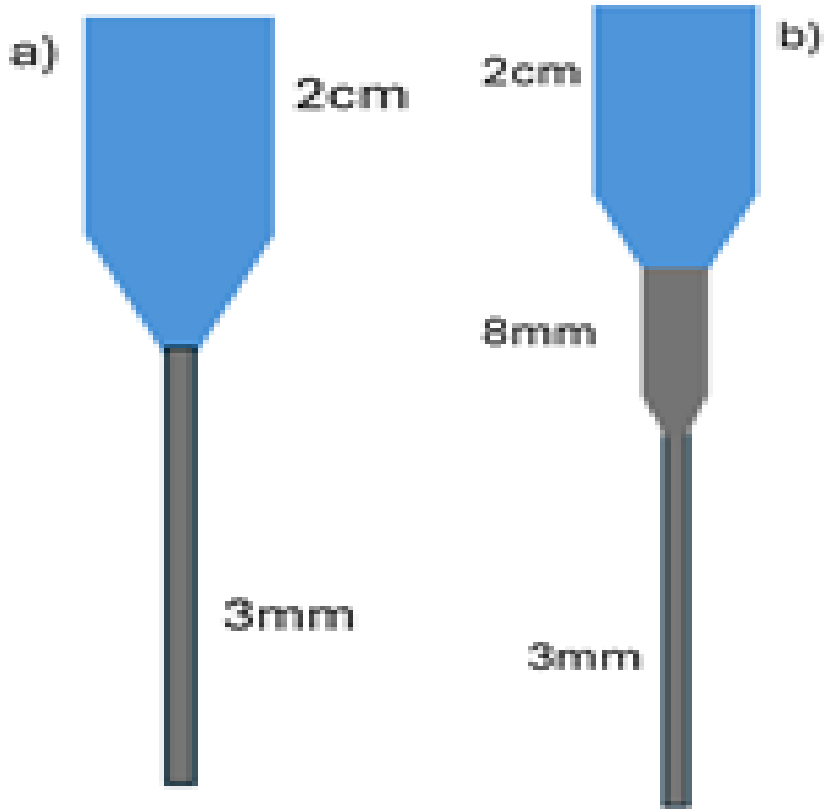
Ø 11 mm head

Ø 10 mm head

Ø 12 mm head

Ø 12 mm head

Ø 12 mm head



See the talk of Iryna Buchovska