

Summary

The StarJet technology features a pneumatically actuated printhead that allows for the direct printing of molten metal (Sn95Ag4Cu @ 310 °C) as individual droplets or as a jet. The technology consists of a heatable printhead with an interchangeable star-shaped nozzle chip (Figure 1) [1, 2]. The printhead is mounted on an industrial printing platform that allows for a precise deposition of metal droplets or lines on substrates.

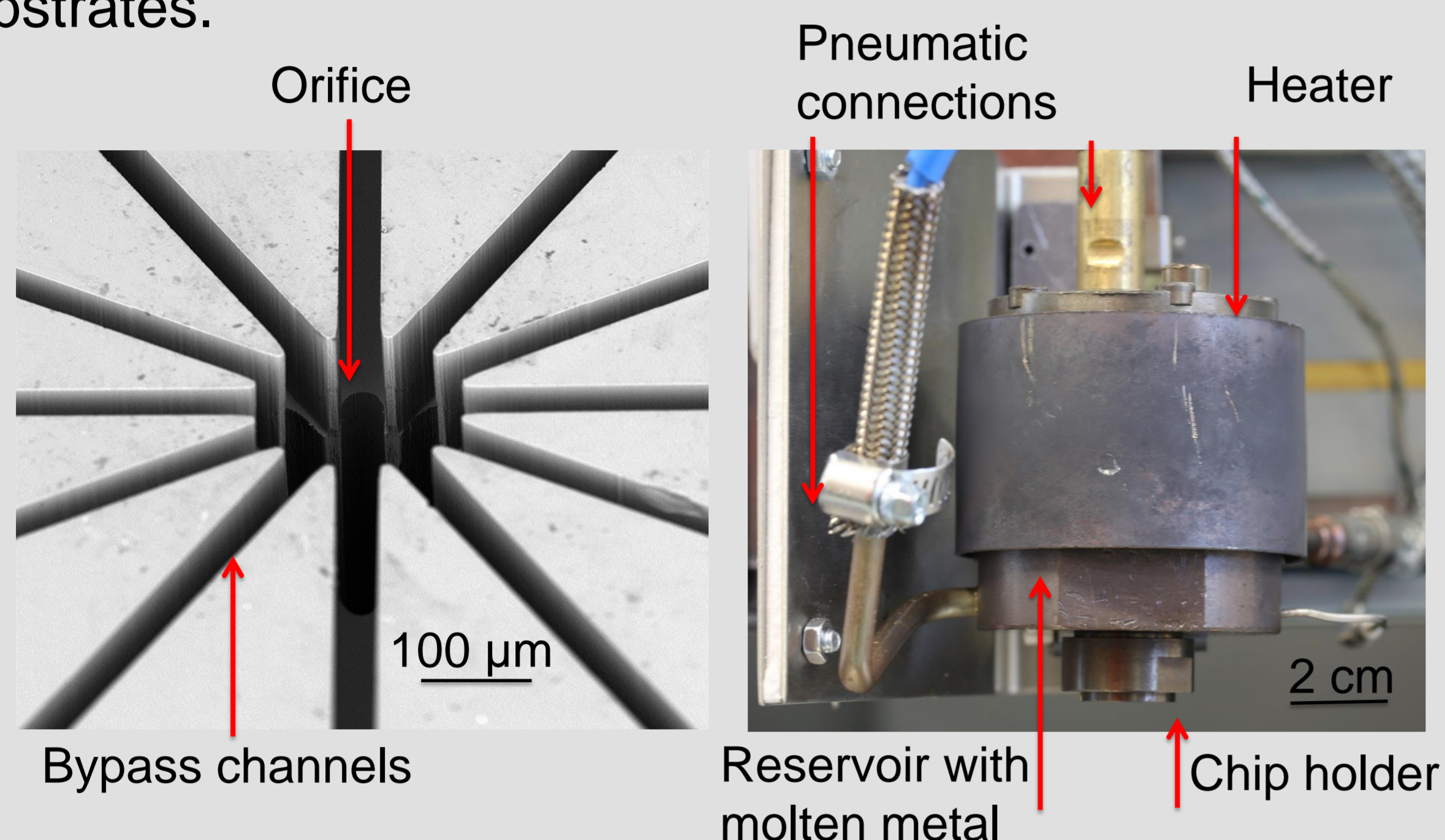


Figure 1: SEM view of a StarJet nozzle chip (left) and an assembled printhead (right).

Motivation

Additive manufacturing/ 3D printing of metals is bound to become a major growth market (e.g. fabrication of sensors and actuators, direct metallization of electrical components) and has gained increasing interest in the past [3, 4].

Experimental setup

- MEMS-fabricated star-shaped silicon nozzle chip (Figure 1) featuring bypass channels allowing co-flowing rinse gas
- Pneumatically actuated printhead is driven by applying pressure pulses to the actuation inlet of the printhead while a rinse gas is constantly applied
- Printhead-chip assembly is mounted on Nordson/ Asymtek platform (Spectrum II S2-910, Figure 2), capable of inline-printing and small sample batch production

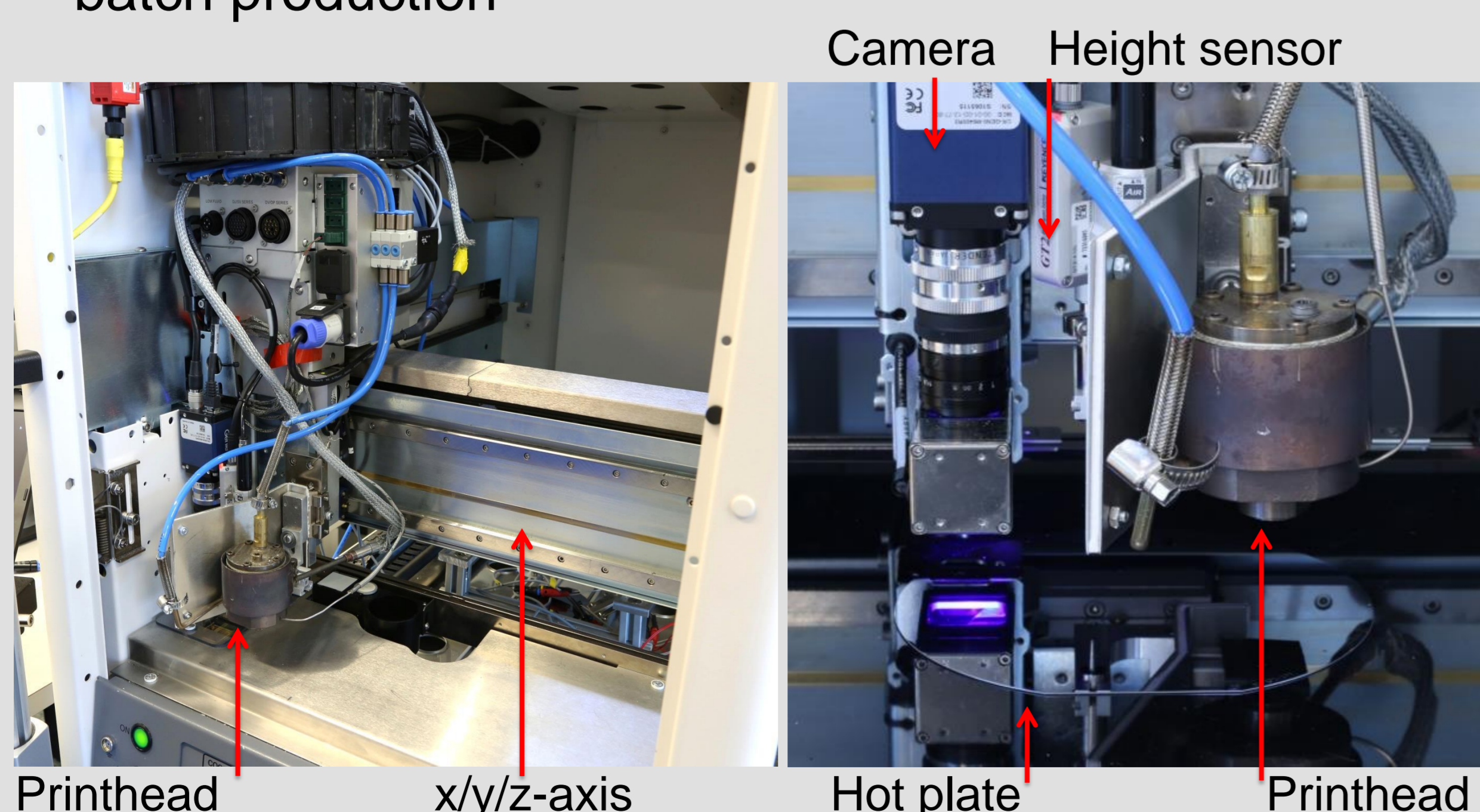


Figure 2: StarJet printhead mounted on an industrial printing platform (left), close-up of StarJet printhead (right).

Experimental results

In this study, the StarJet printhead is mounted on the denoted printing platform and has been used to directly print lines of molten metal with a mean width of about 180 μm. Exemplary lines with a total length of 100 mm are printed close to each other (Figure 3, left) and are analyzed regarding width reproducibility. Therefore, the width of the individual lines is measured for each line in increments of 5 mm. The mean line width of all lines amounts to 182 μm whereas the maximum coefficient of variation of an individual line amounts to 14 μm.

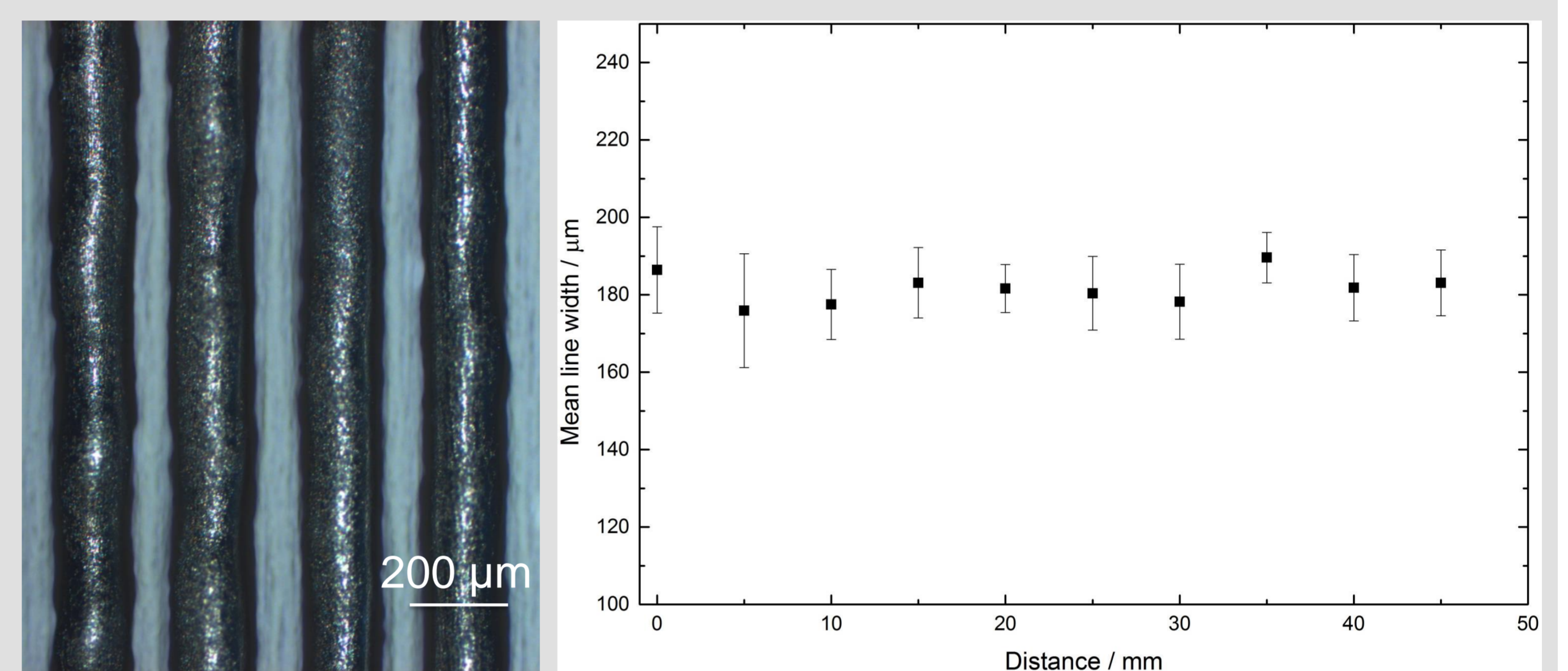


Figure 3: Micrograph of printed solder lines with 182 μm mean line width (left), measured line width of 10 lines across their length in 5 mm increments (right).

Conclusion

The StarJet-based printhead has been successfully integrated on an industrial printing platform and is applied to print lines of molten metal with mean widths of 182 μm and a maximum coefficient of variation of 14 μm. Deposition velocities up to 1 m/s can be realized.

Acknowledgements

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References

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