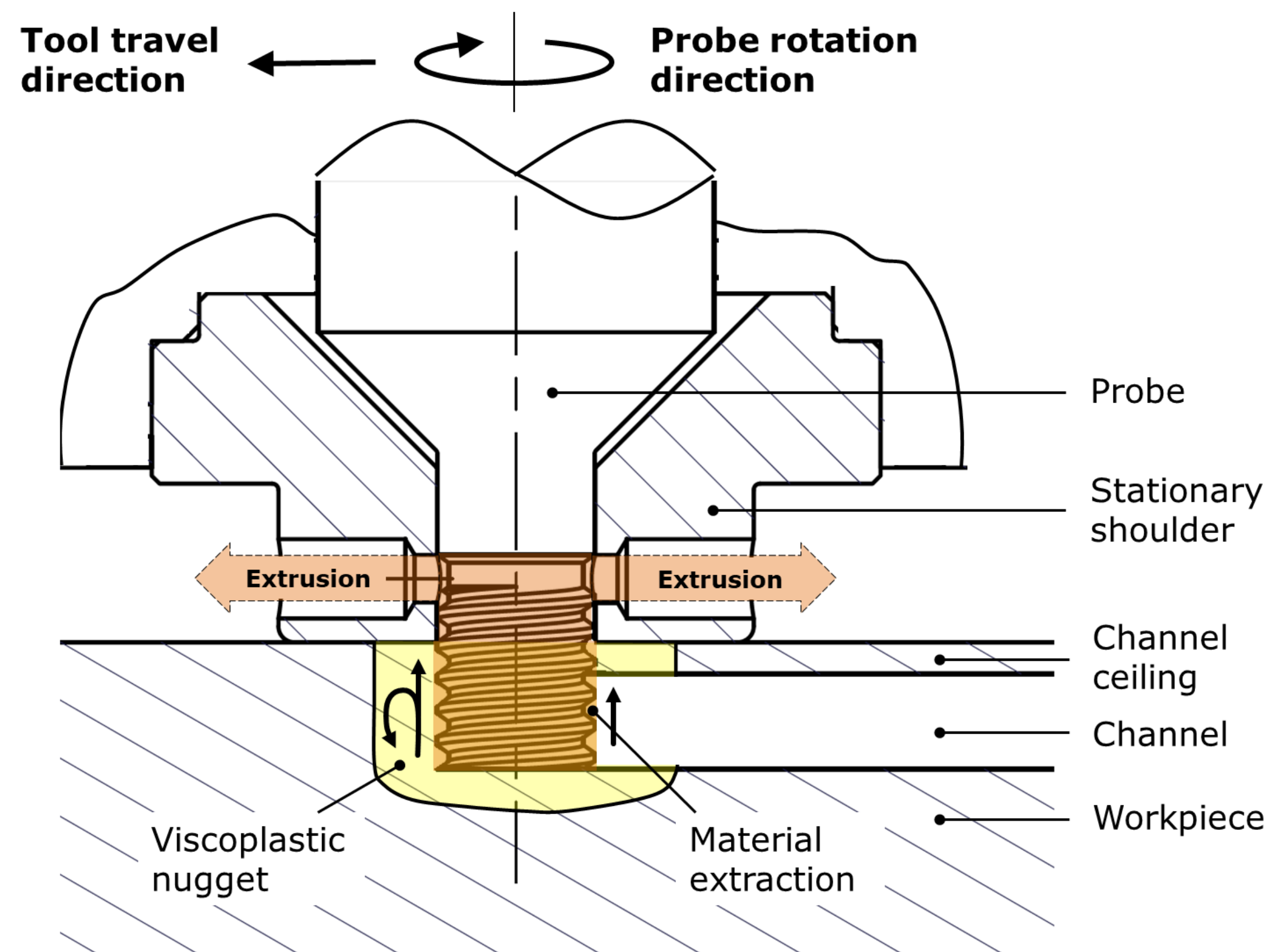


# Latest developments on manufacturing cooling channels in copper using CoreFlow®

## 1 Introduction

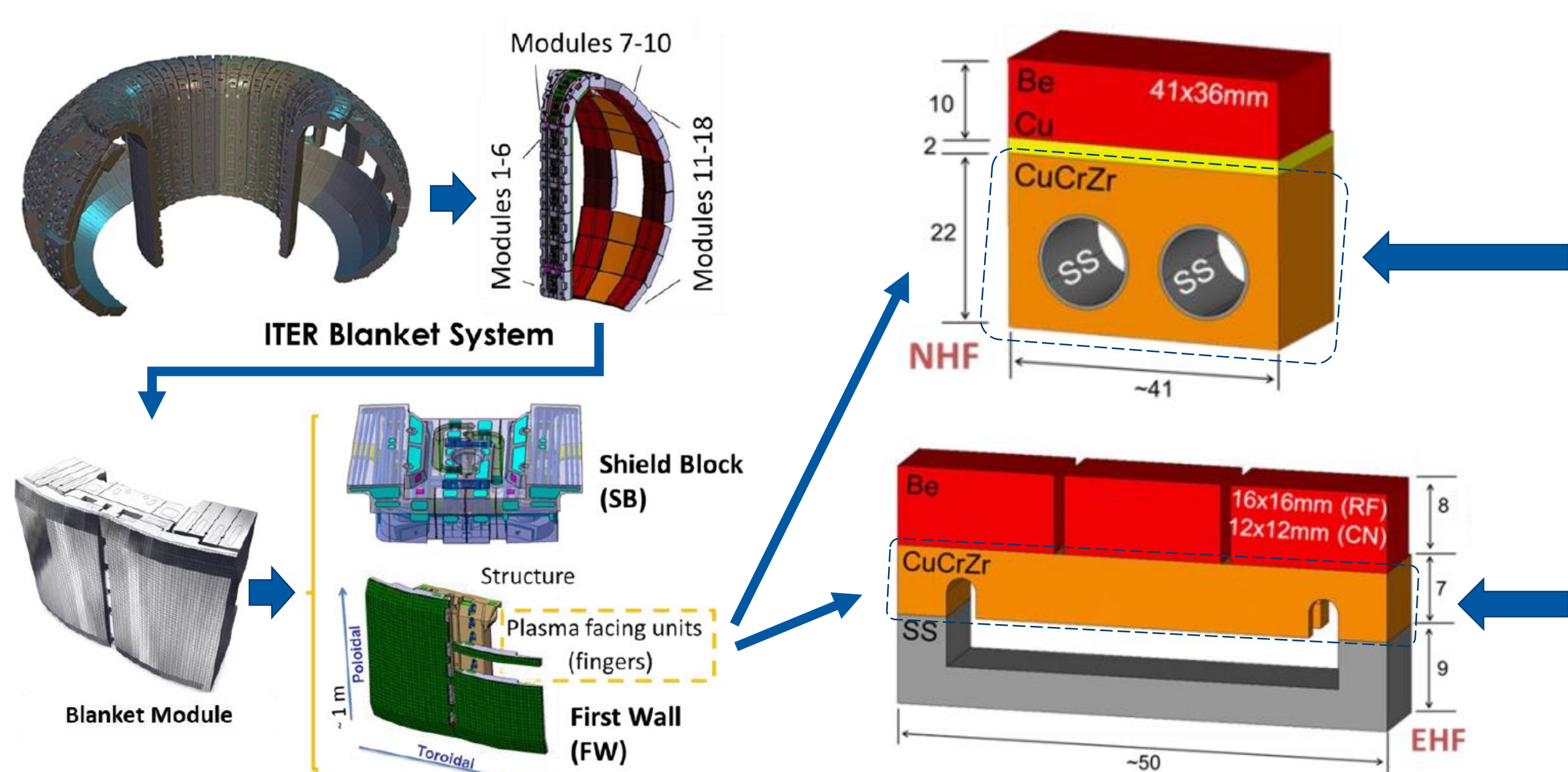
CoreFlow = Stationary shoulder friction stir channelling



- CoreFlow is a novel sub-surface machining process which is currently being developed as an alternative method for manufacturing embedded channels in monolithic structures.
- Research and development trials were performed on C101 (commercially-pure) copper to improve on the channel cross-section and consistency of channels along longer path lengths.

## 2 Application

Novel manufacture of cooling channels within plasma facing component (PFC) copper alloy heat sinks.

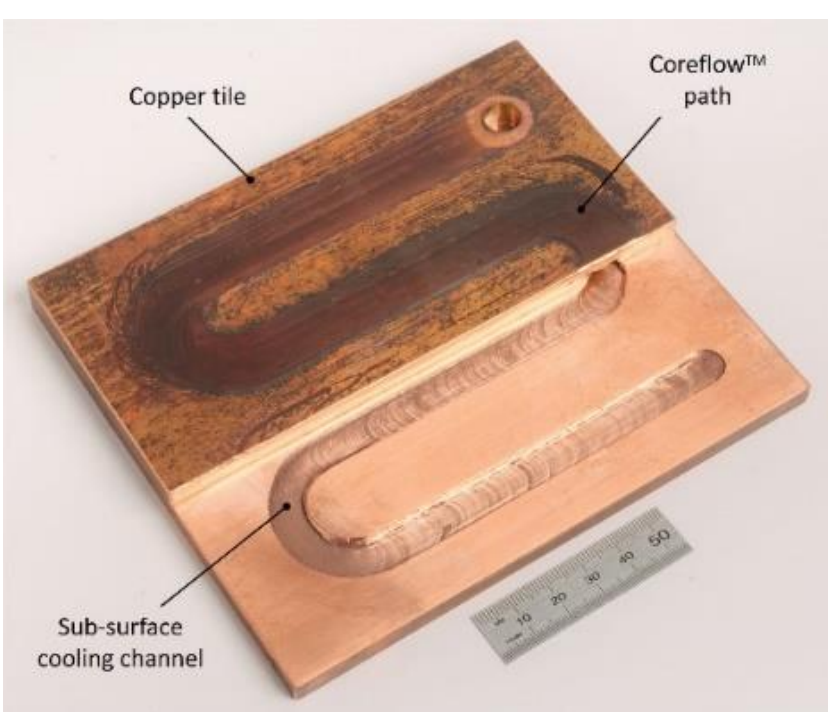


Images courtesy of UKAEA

### Current gun-drilling or HIPing approach

- o High cost.
- o Long lead time.
- o Compromised design.
- o Difficult to qualify.
- o Multi-material.

### Innovation with CoreFlow



- o Single-step process.
- o Enables optimised channel design.
- o Capable of 3D paths.
- o Parent material.
- o Reduced complexity for qualification.
- o Waste reduction.

## 3 Objectives

Prove feasibility within C101 (commercially-pure) copper.

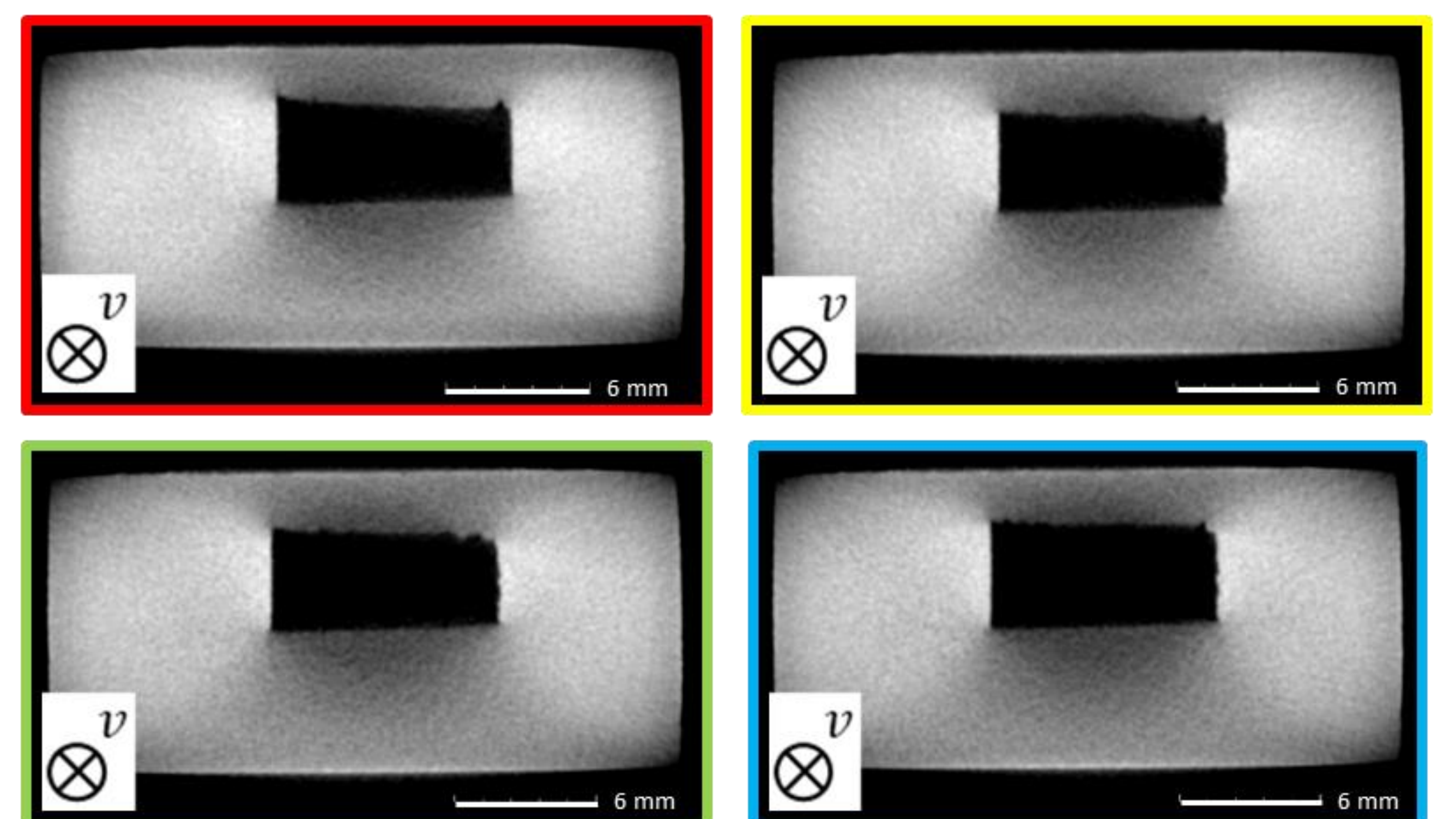
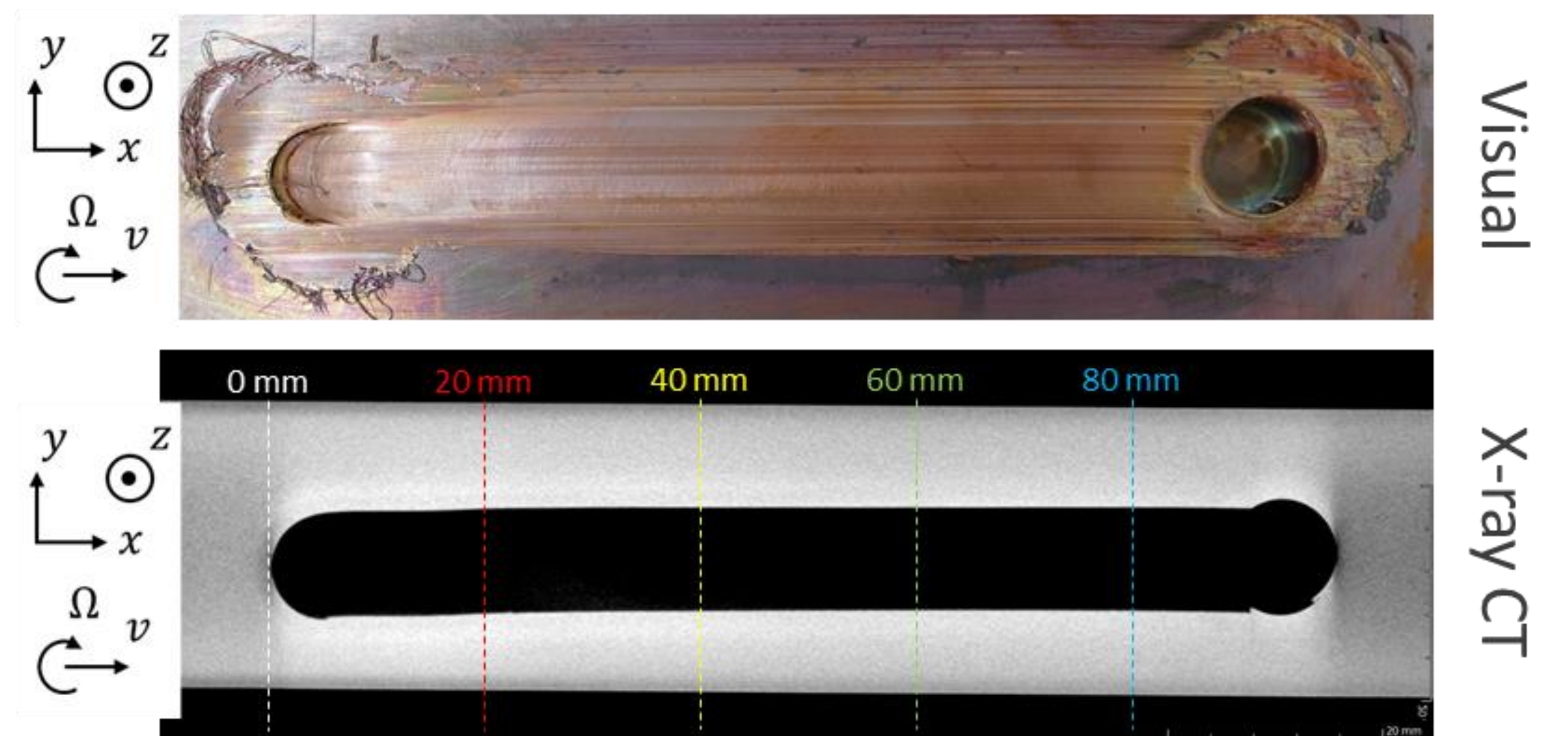
Explore 2D channel path capabilities.

Process window investigation.

Produce TRL 4 sub-scale demonstrator.

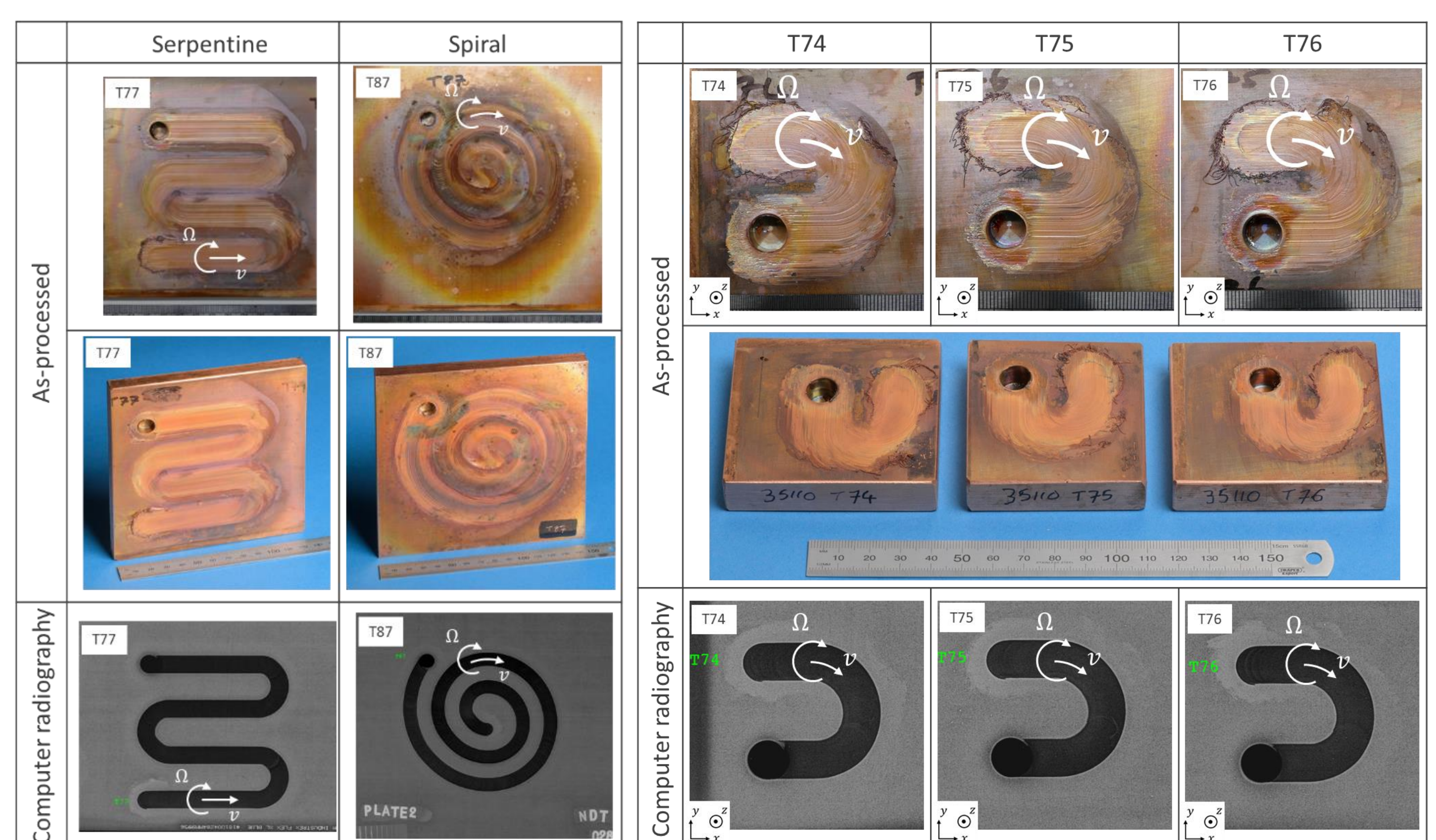
## 4 Results

Channel cross-section development



2D path exploration

3 OFF TRL 4 demonstrators



- Process parameters optimised to create 10 mm wide x ~4 mm tall channels, proving feasibility for application.
- Channel burst pressures in excess of 650 bar achieved.
- Successful complex 2D channel paths demonstrated.
- Repeatable TRL 4 demonstrators produced, capable of simulated environment testing.

## 5 Future work

Maturation of process for optimised channels.

Develop suite of NDT qualification techniques.

Validation of TRL 4 demonstrators.

Scale-up process to larger demonstrator components.