

Fields of Competence

- Welding technology and welding metallurgy
 - Material-physical processes during welding
 - Metallurgical processes during welding
 - Process and material studies of welding technology
- Joining processes with reduced heat input
 - Joining of non-metallic and dissimilar materials in fuel cells with vacuum brazing, furnace brazing and reactive air brazing
 - Ultrasonic joining of dissimilar materials in fuel cells
 - Mechanical joining of material compounds



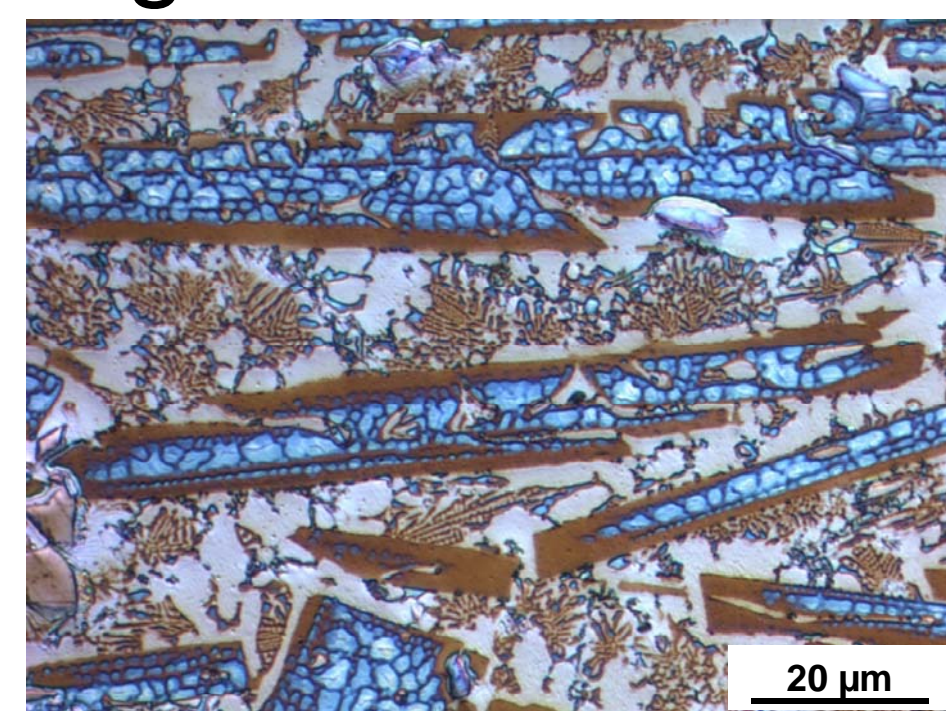
ceramic-ceramic joint realized with reactive air brazing

Characterization of joints

- Destructive testing under static, cyclic and dynamic loads
- Temperature depended testing
- Non-destructive joint testing

Surface engineering and wear protection

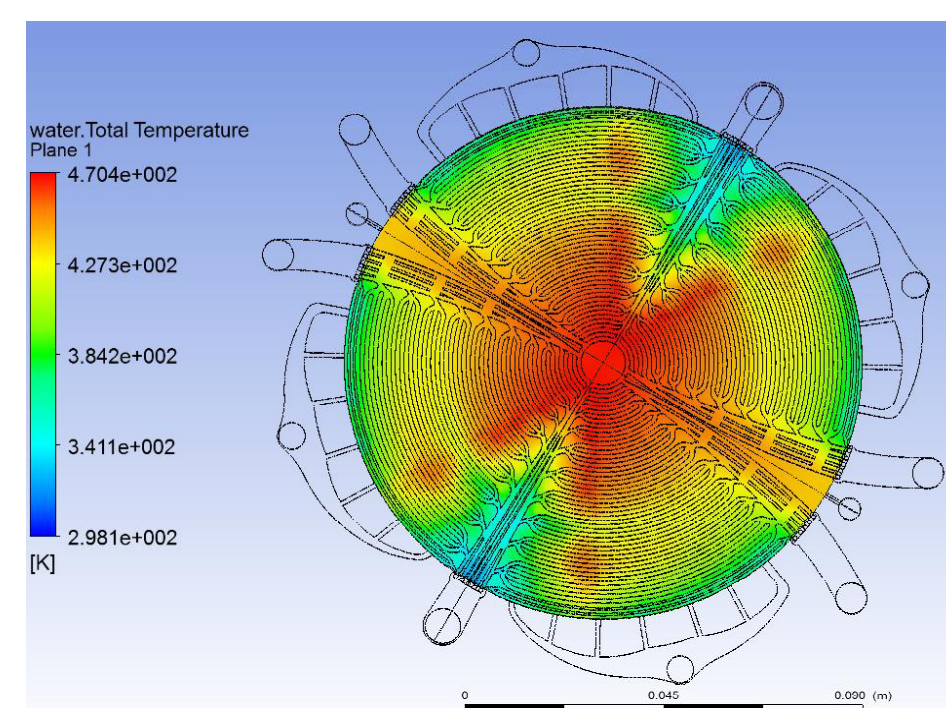
- Optimizing of tribological systems
- Wear testing
- Development of wear resistant materials
- Coating technology (micro / macro layers)



Fe-based coating by PTA process, directionally solidified

Numerical simulation

- Simulation and analysis of gas flows in welding processes
- Flow field simulation in fuel cells
- Electromagnetic heating and forming process simulation of pressure welding processes



simulated temperature distribution in a fuel cell membrane electrolyte assembly

Equipment

Joining and coating equipment

- MIG / MAG power sources among others with controlled short arc
- TIG and plasma power sources
- Laser and laser hybrid
- Resistance spot welding machines
- High frequency welding machine
- Welding robot and CNC table
- Furnace brazing and vacuum brazing systems
- Ultrasonic welding facility
- PTA system
- Physical vapor deposition (PVD)
- High power pulse magnetron sputtering (HPPMS)



PVD / HPPMS facility at Clausthal center of material technology (CZM)

Test equipment

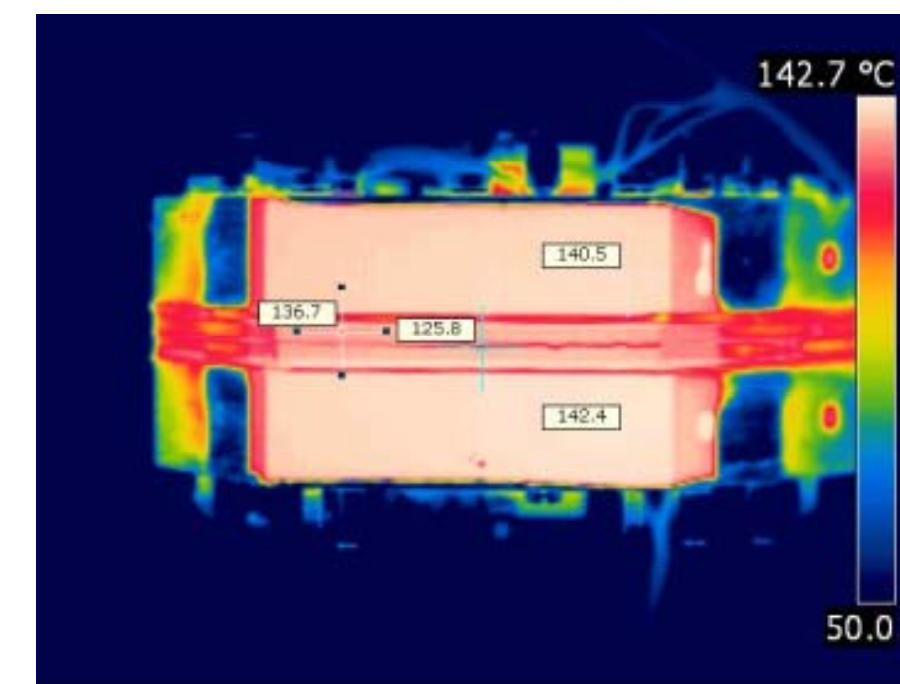
- High speed testing machine ($F_{max} = 160\text{ kN}$, $v_{max} = 20\text{ m/s}$)
- High frequency resonance testing machine including fracture mechanic analysis
- Thermomechanical testing system for instrumented tensile tests
- Several wear tests according to ASTM standards
- Special wear tests to customer specifications



high speed testing machine with implemented clamping devices for tensile tests

Analyzing

- High speed imaging camera
- Image correlation software for strain-stress analysis
- Thermo imaging camera
- Determination of oxygen, nitrogen and hydrogen in solid materials
- Automated micro hardness tester
- CCT-diagram analyzer
- Magnetical microstructure analyzer



thermographical image of a working fuel cell

Contact

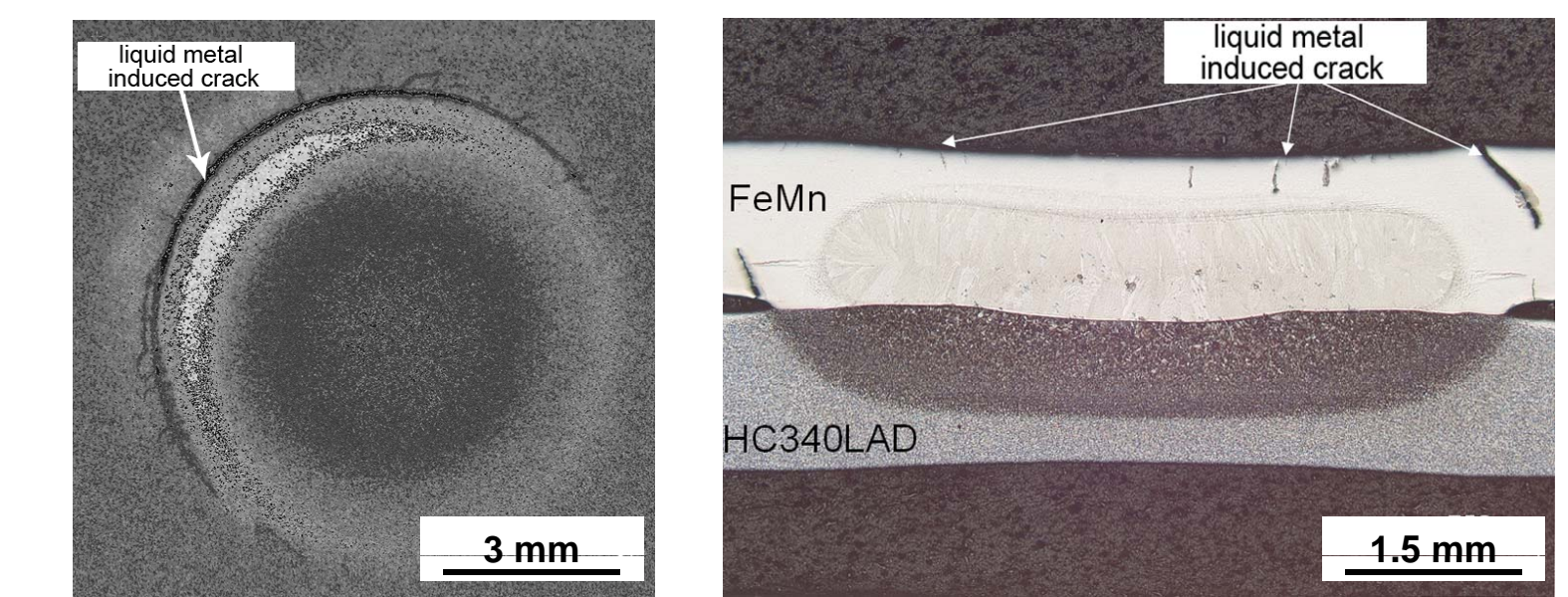


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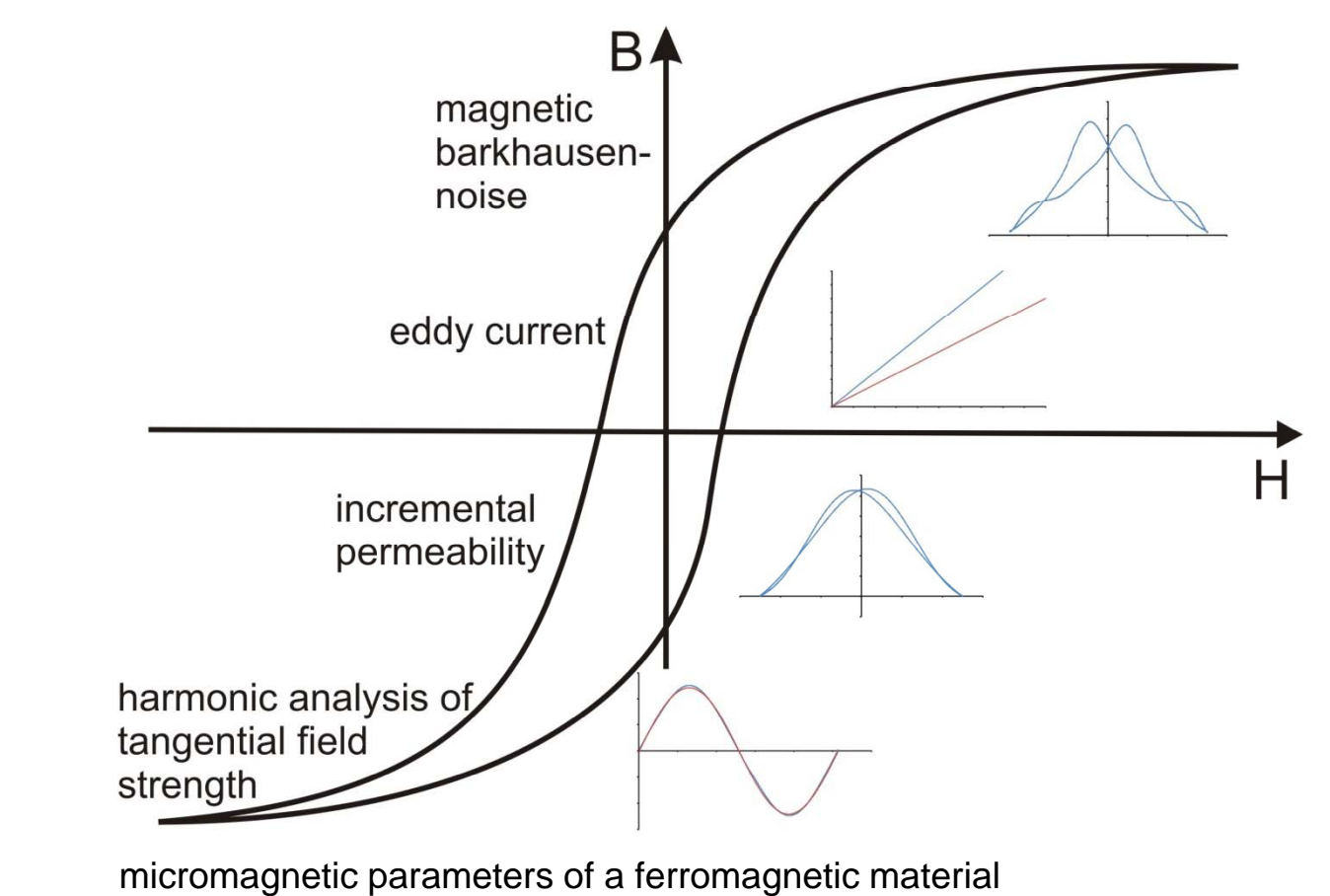
Key Aspects of Research

Metallurgical and material-physical orientated joining technology

- Analysation of liquid metal embrittlement during resistance spot welding of novel iron-manganese steels
- Systematic and independent identification of the existing ranges of liquid metal embrittlements in an instrumented thermomechanical testing system
- Transfer of insights gained through the model test on the spot welding process for the production of crack-free welds
- Inventing a concept for test, joining and weld seam treatment to reduce weight of agricultural and forestry machinery and equipment
- Used materials: thermomechanically rolled fine grained steels
- Increasing lifespan through pneumatic impact weld seam treatment
- Test method: analyzing magnetic structure



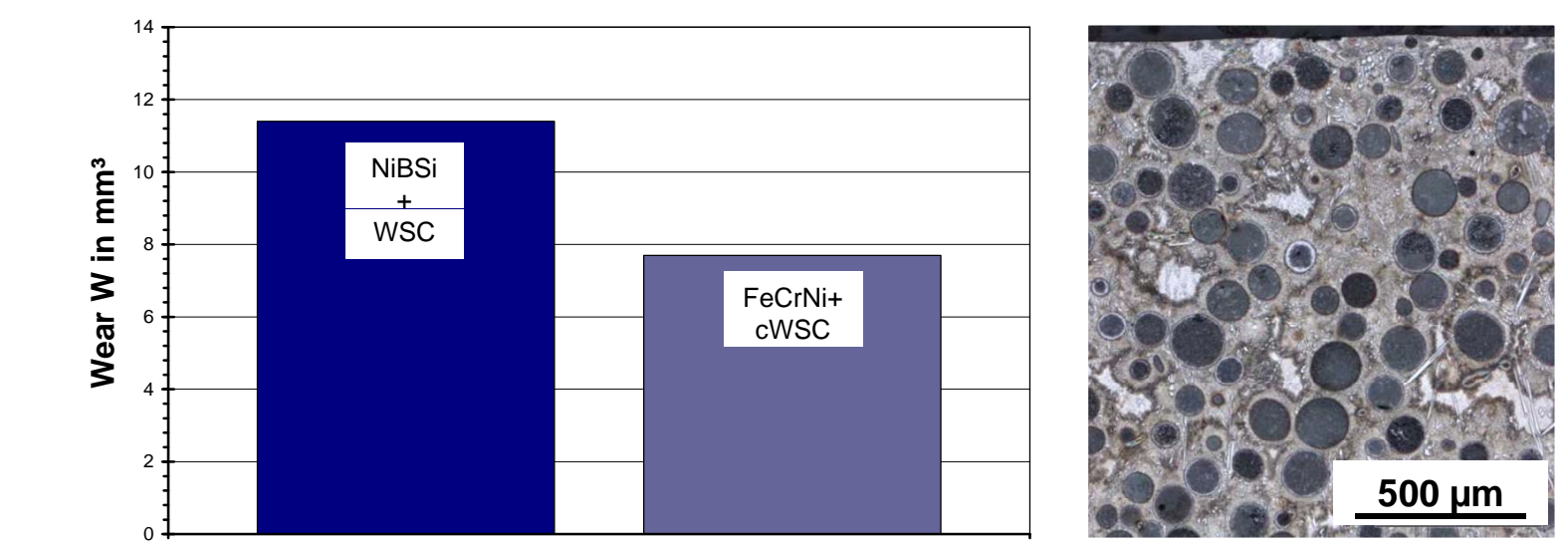
resistance spot welded joint between a zinc coated iron-manganese steel and a micro alloyed ferritic steel



micromagnetic parameters of a ferromagnetic material

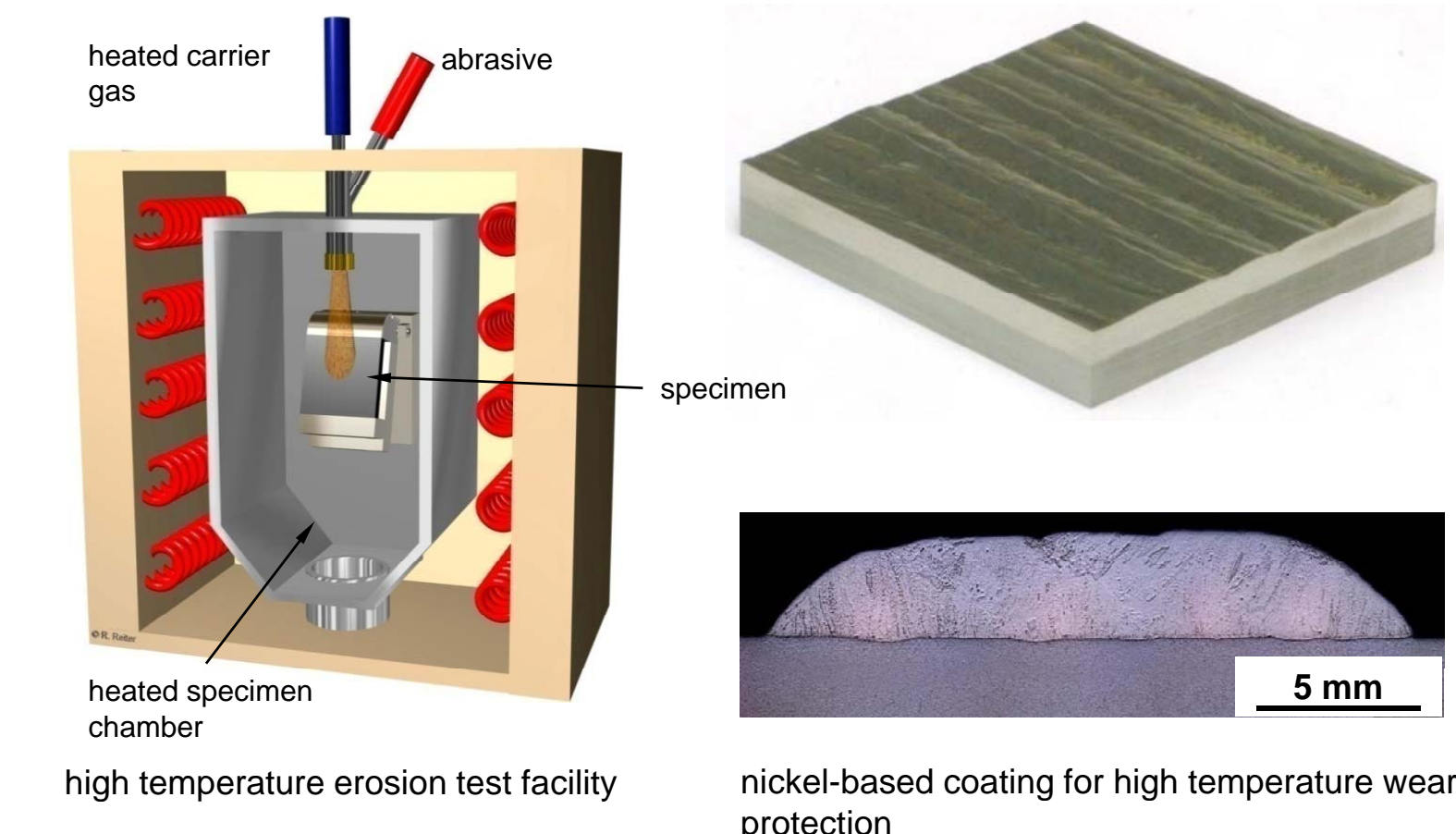
Developing and qualifying of wear resistant coatings

- Development of new low cost Fe-hard alloys for technical and farming knives etc. without reducing the wear performance
- Usage of effective geometries
- Development of tungsten carbides (TC and CTC) reinforced Fe-hard alloys



in comparison the removal of wear resistant coatings microstructure of a tungsten carbide reinforced Fe-hard alloy

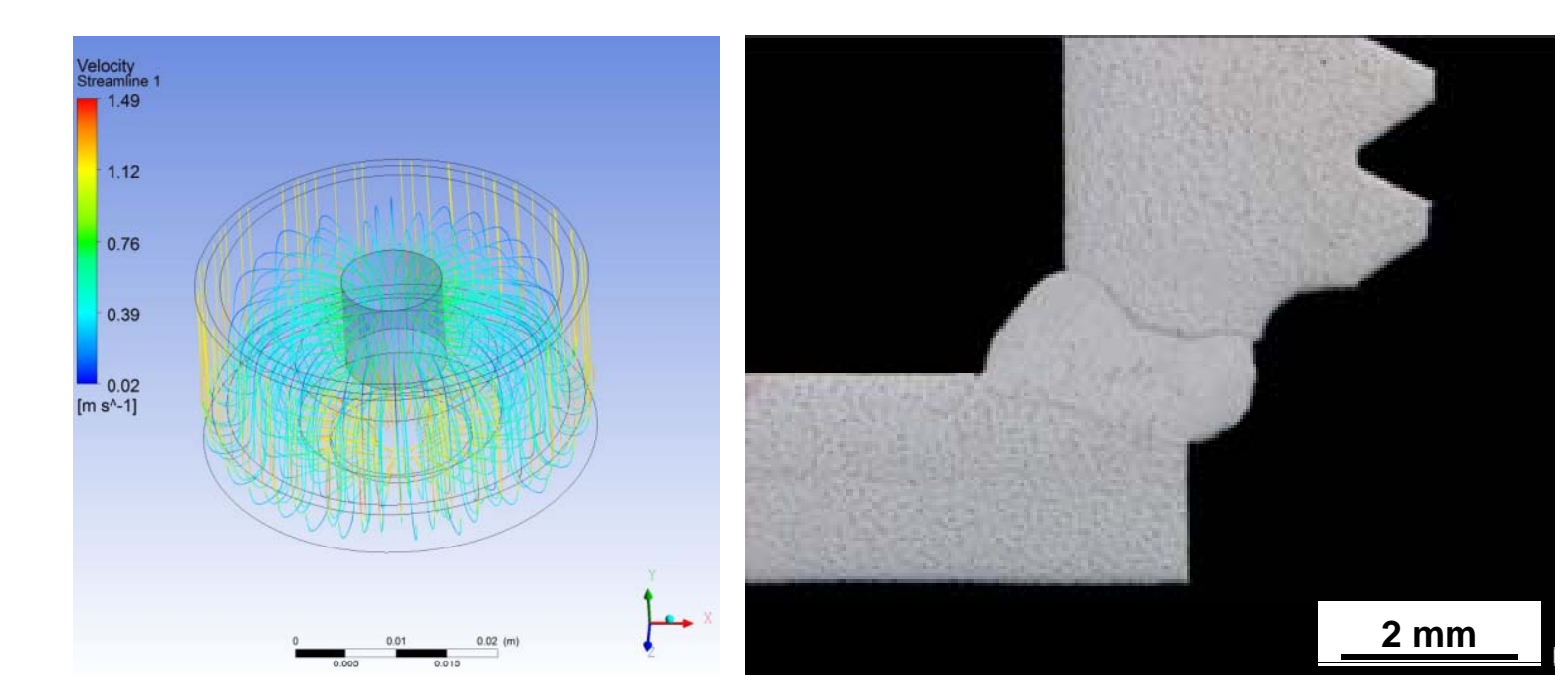
- Reinforcement of nickel-based superalloys with different kind of carbides (TiC, WC etc.) for high temperature applications
- Coating generation by plasma welding and controlled short arc
- Qualification by high temperature erosive wear test stand up to 800 °C and preheated abrasive



high temperature erosion test facility nickel-based coating for high temperature wear protection

Process optimization through simulation

- Application of pad welding with magnetically moved arc for different types of hexagonal screw nuts using an universal welding pistol
- Initial situation: each screw nut needs a different type of welding pistol
- Main requirement: pore-free weld seam
- Gas flow simulation induced pistol design to achieve target



simulated shielding gas flow velocity in a pad welding nozzle joint zone between a screw nut and a bored sheet metal