Institut für Werkstoff- und Fügetechnik

Wissenschaftliche Gesellschaft Fügetechnik e.V. im DVS

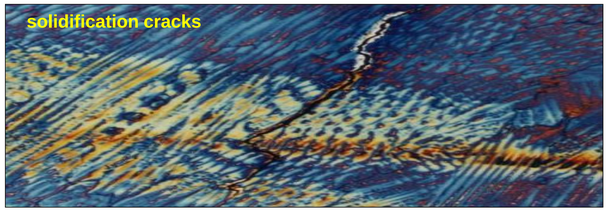
Fields of Competence

Development of Welding Technologies

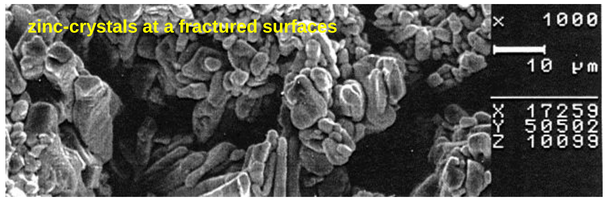
- GMA welding for high strength steels
- resistance spot welding for dissimilar metals
- ultrasonic welding
- deposition welding / coating

Joining Suitability / Welding metallurgy

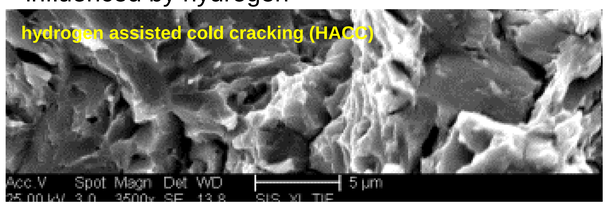
- sensitivity to welding cracks (high strength low-alloyed steels, ultra-high strength steels, Ni – superalloys, Al- and Mg – alloys)



- influenced by coating systems



- influenced by hydrogen



Hot Formed High Strength Steels

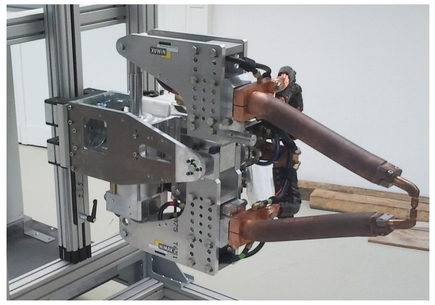
- hot forming and quenching processing with different furnace atmosphere and cooling rates
- adapted welding technologies
- Hot and cold crack formation influenced by surface layer, hydrogen and welding conditions

Testing of Materials

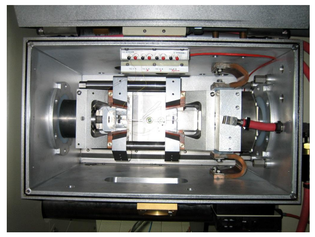
- destructive testing incl. thermo-mechanical testing
- non-destructive testing (acoustic emission analysis, special micro-magnetic and radiographic testing)
- Corrosion testing with electrochemical and chemical test methods

Equipment

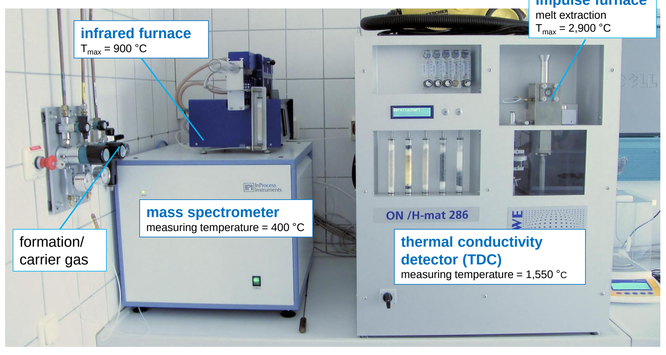
- GMA welding power sources and devices (conventional, orbital and robot)
- Nd:YAG and CO_2- Laser beam welding and cutting machines
- Resistance welding machines



- Gleeble® 3500 – device for thermo-mechanical testing of alloys



- advanced & accurate gas analyzer for measurement of H_2, O_2 and N_2 in metals with high resolution



- wide range of testing devices for hot and cold crack analysis

Kontakt

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Key Aspects of Research

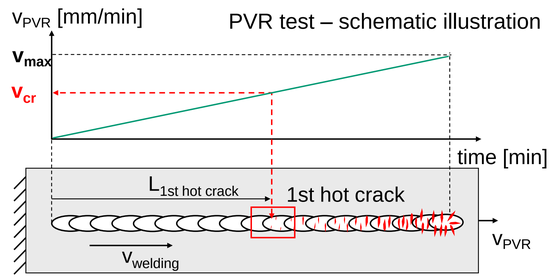
Analysis of Weld Cracking

Initial Situation

- Several types of cracks may occur in welds or heat affected zones. Hot cracks occur at elevated temperature, cold cracks occur after the weld metal has cooled to room temperature. Investigations of the cause of cracking and the susceptibility of new materials are of high importance.

Approach to Solution and Results

- A careful analysis of crack characteristics by metallographic and metallurgical methods is required to determine the cause of cracking.
- A number of weldability tests (e.g. PVR test) are used to determine the cracking susceptibility of base and filler metals.



Micrographs of hot cracks in welds after PVR-test

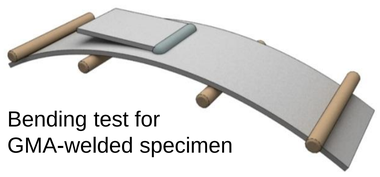
Weldability of High Strength Quenched Boron Steels

Initial Situation

- Properties of welding are strongly influenced by welding parameters.
- Hydrogen from heat treatment or welding process can result in delayed fracture.

Approach to Solution and Results

- Optimization of process parameters for GMAW, Laser- and RP-Welding
- Development of test procedure for HACC in quenched thin walled components
- Conditions for crack formation after welding



Bending test for GMA-welded specimen

HACC in resistance spot welding of quenched boron steel after bending test

Non-Destructive Testing

Motivation

- Determination of hardness with low cost testing device in components and HAZ of weldings
- Verification of delayed fracture in high strength steels caused by HACC
- process control for joining of reinforced plastics

Approach and Results

- Development of magnetic field sensor system for hot formed components .
- Adaption of sound emission testing for crack determination in welded specimens
- Eddy current imaging of joints with reinforced plastics

Eddy current image of a patched stringer plate from carbon fibre-reinforced plastics