TECHNISCHE UNIVERSITÄT DRESDEN

Project idea

Hot-cold Tandem GMAW

Partial decoupling of material transfer and energy input for increased process capability and productivity

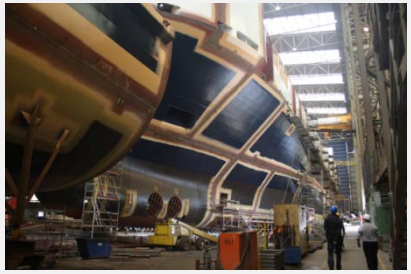
Technische Universität Dresden
Chair joining and assembly
Research Group *Arc Processes*
Dr.-Ing. Sascha Rose

DRESDEN concept
Exzellenz aus Wissenschaft und Kultur

Characteristics of gas metal arc welding

- Most important thermal joining process
- Very flexible in use – manually or automatically

⇒ **GMA welding is the most important joining process in Europe and worldwide (e. g. 80.000 welders in Germany alone)**



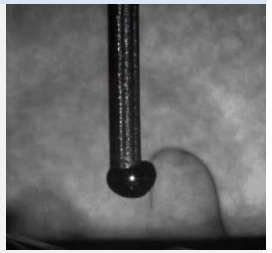
FSG



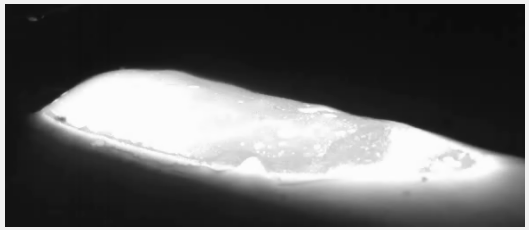
Volkswagen

Future challenges for gas metal arc welding

1. Joining of multi-materials
⇒ Heat input of GMAW processes has to be decreased (intermetallic phases).



2. Integration in virtual development environment.
⇒ Weld seam formation has to be predictable.



3. Higher demands on occupational health
- Fume Emission has to be limited.

⇒ **New GMAW-processes are necessary to address these challenges.**
⇒ **New GMAW-processes have to keep productivity high and have to be suitable for SMEs.**

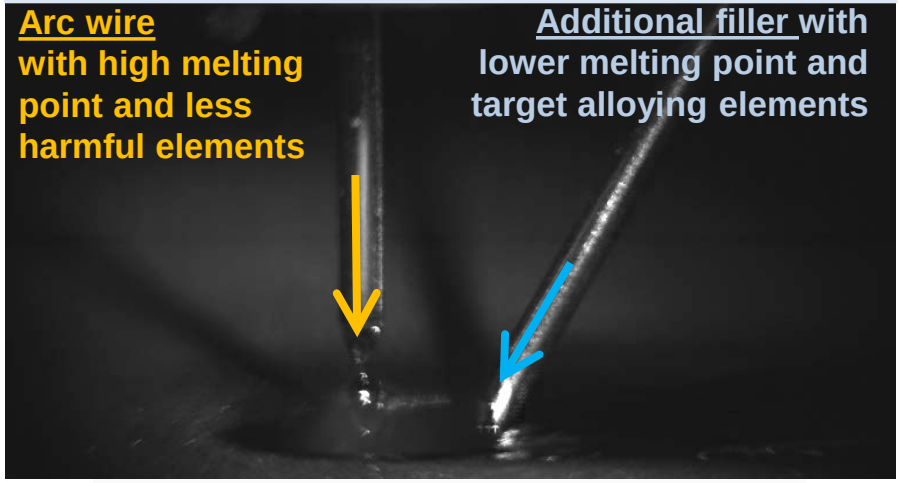
Hot-cold Tandem-GMAW

Partial decoupling of material transfer and energy input for increased process capability and productivity

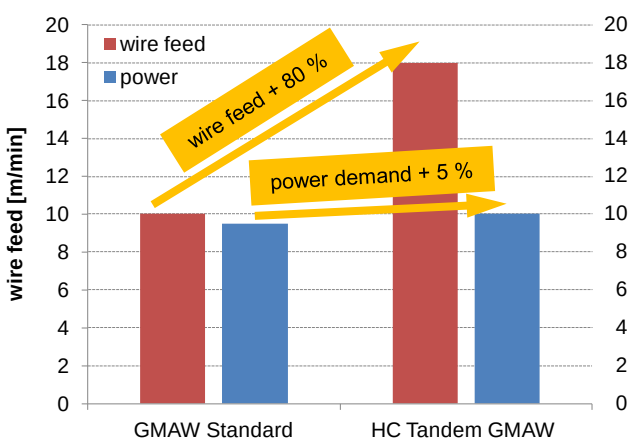
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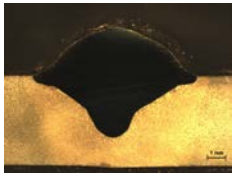
New *HC Tandem GMAW concept* opens up new opportunities for European manufacturing industry.

Principle

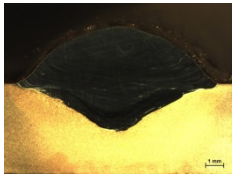


Increased process efficiency



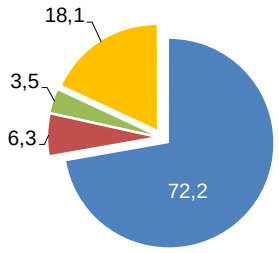


Standard GMAW

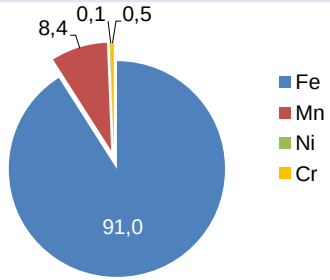


HC Tandem GMAW

Fume emission depending on evaporation



Standard GMAW
(wire X5CrNi-18-10)



HC Tandem GMAW
(filler X5CrNi-18-10)

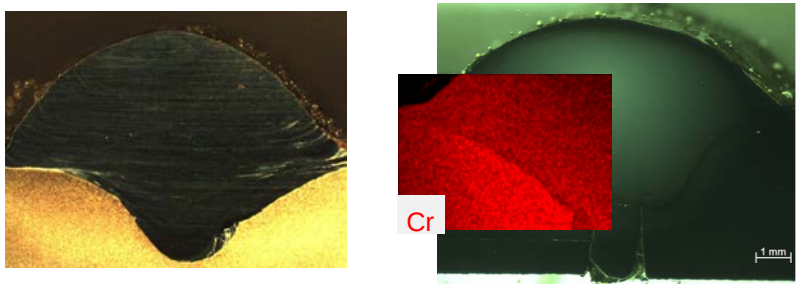
Process advantages

- Melting efficiency increases by more than 70%.
- Additional Filler wire is only heated to melting temperature. Thermal stress is reduced by more than 1000 K

⇒ **Lower heat input. Evaporation and fume emission decrease by more than 95%.**

New *HC Tandem GMAW concept* opens up new opportunities for European manufacturing industry.

Feasibility study on high alloyed steel (German granted project)



left: homogenous chromium distribution in complete weld seam
right: joining with intentionally less absolute chromium content in weld seam

- Complete mixture of all elements in the whole weld seam is achieved by using hot additional wire.

⇒ Weld pool is cooled by second wire.

⇒ Weld seam composition can be regulated independent from process influence, e.g. welding of volatile materials like zinc and magnesium.

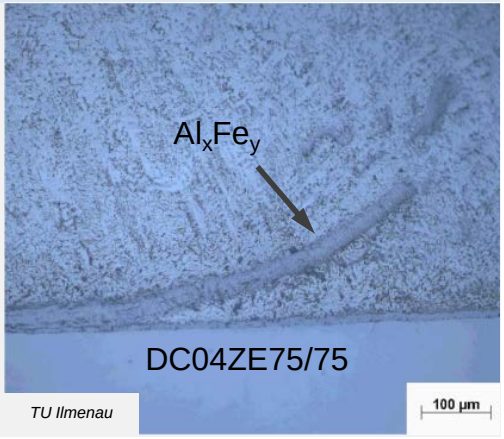
Further research

- Feasibility tests proofed new concept on limited material combinations:
  - Carbon to high alloyed steel
  - Aluminum to magnesium

⇒ Further research for a comprehensive understanding of process suitability on all industrial relevant material combinations
  - e. g. intermetallic phases in aluminum-steel could be avoided

⇒ **Aluminum-steel applications**

⇒ **High-alloyed steel applications**

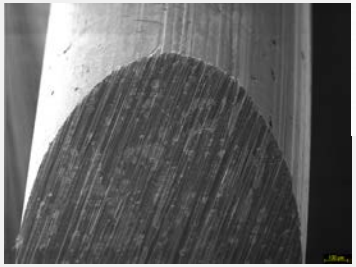


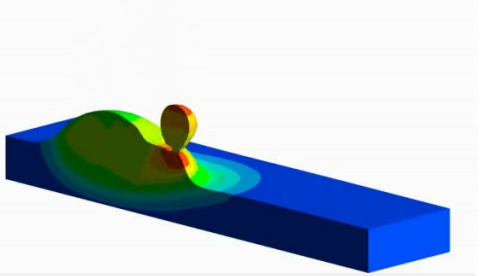
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Invitation to collaboration

Tasks to be worked on:

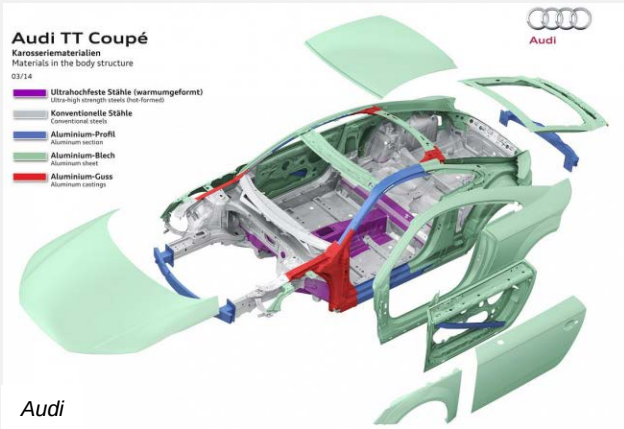
- Further process development
- Process prediction by numerical simulation
- Simulation of metallurgy in the weld seam
- Materials compatibility
- Creation of new alloying concepts





Potential partners:

- Industrial users
  - Automotive and transportation
  - Energy and infrastructure
  - Chemical apparatuses
- Filler / material producers
- Welding equipments manufacturer
- Material science institutes
- Testing and certification institutes



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