WETTABILITY AND SINTER-BRAZING

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MOTIVATION AND OBJECTIVES

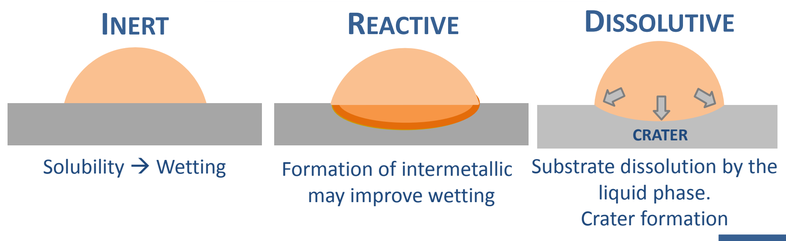
SINTER-BRAZING

- ✓ **Complex geometries**
- ✓ **Joint of dissimilar materials**
- ✓ **No increase in nº steps of manufacturing route**

BRAZING ALLOY DESIGN…
- Infiltration
- Solubility liquid-solid
- Intermetallics
- Porosity base material

WETTING BEHAVIOR OF THE LIQUID PHASE → SINTER-BRAZING SUCCESS

LIQUID-SOLID INTERACTION

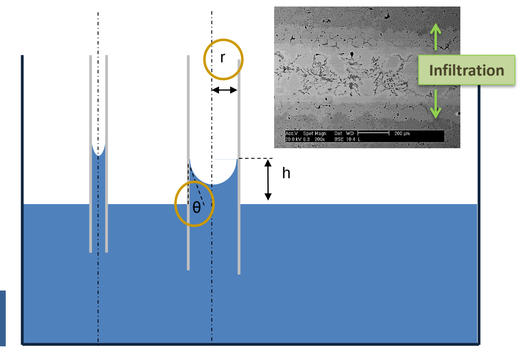


Solubility → Wetting

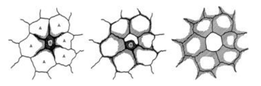
Formation of intermetallic may improve wetting

Substrate dissolution by the liquid phase. Crater formation

Low dissolutive liquid & Porosity of the solid → CAPILLARITY



GOOD WETTING CAPACITY (θ) → INFILTRATION THROUGH PORES WITH SMALLER DIAMETER (r)

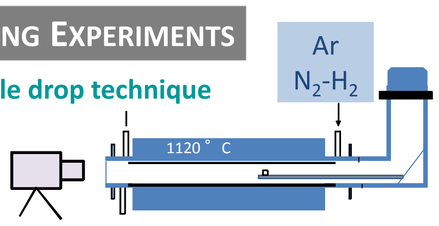


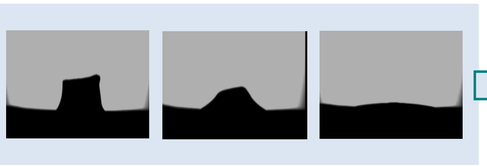
SMALLER PORES → HIGHER CONTACT SURFACE BETWEEN LIQUID AND SOLID

EXPERIMENTAL PROCEDURE

WETTING EXPERIMENTS

Sessile drop technique





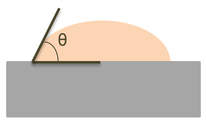
Cross-section

MATERIALS

Fully dense **substrate**
Fe, Fe-0.5C, 316L

Drop
Ni-Cu-Mn-Si-B

EVOLUTION OF THE CONTACT ANGLE (Θ)



θ < 90° good wetting capacity

SEM&LOM
EXAMINATION OF DROP-SUBSTRATE INTERFACE

SINTER-BRAZING TRIALS

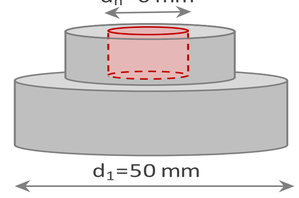
BRAZING ALLOY: NI-CU-MN-SI-B

Base material influence:

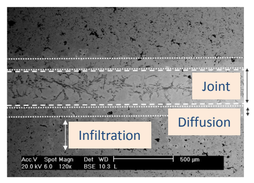
Substrate Comp. (wt. %)	Pressing 600 MPa		Effect
	Green density (g/cm³)	Open porosity (%)	
Fe	7.30	4.90	Reference
Fe-0.4C	6.70	2.55	Effect of C on solubility and infiltration
Fe-0.6C	6.90	2.57	
Fe-0.4C-2Cu	7.10	2.02	Interaction of 2 liquid phases
Fe-0.6C-2Cu	7.10	2.06	

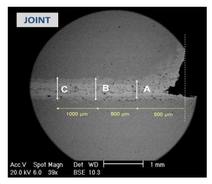
Fe: ASC 100.29 ® Höganäs **C**: Graphite UF4 **Cu**: Copper 200

SET UP FOR TESTING



Sintering 1120ºC, N_2-H_2
Cooling rate: 0.8ºC/s





CHARACTERIZATION

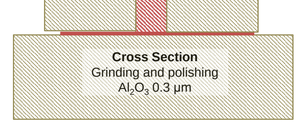


Image Analysis

SEM LOM

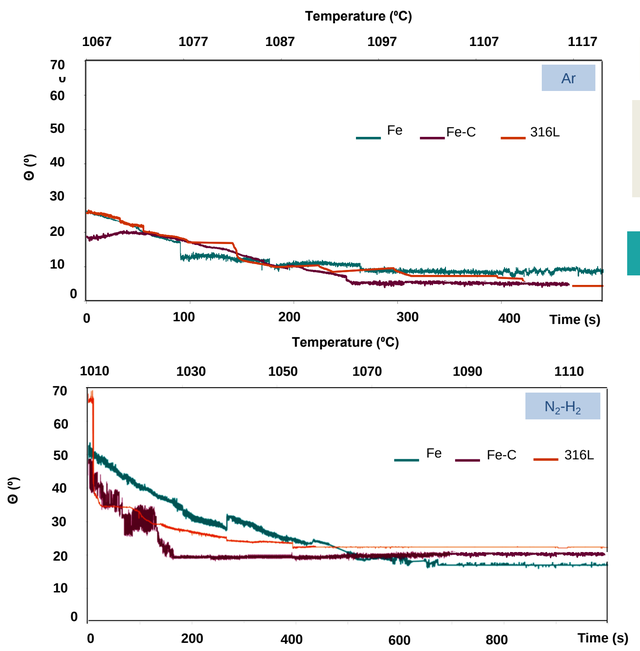
LIQUID PHASE

- **INFILTRATION** into the base material
- **JOINT GAP** filled by the liquid
- **DIFFUSION** of alloying elements between liquid and solid

RESULTS

WETTING BEHAVIOUR

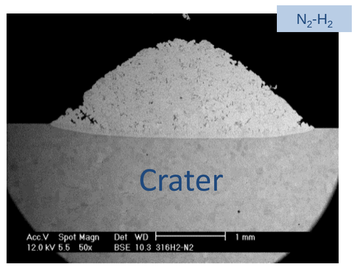
Good wetting capacity of the liquid phase for carried out experiments



EFFECT OF SUBSTRATE COMPOSITION

- ✓ C: ↓θ, carbothermic reduction 700 ° C
- ✓ 316L: ↑θ, stable Cr oxides

INFLUENCE OF THE SINTERING ATMOSPHERE

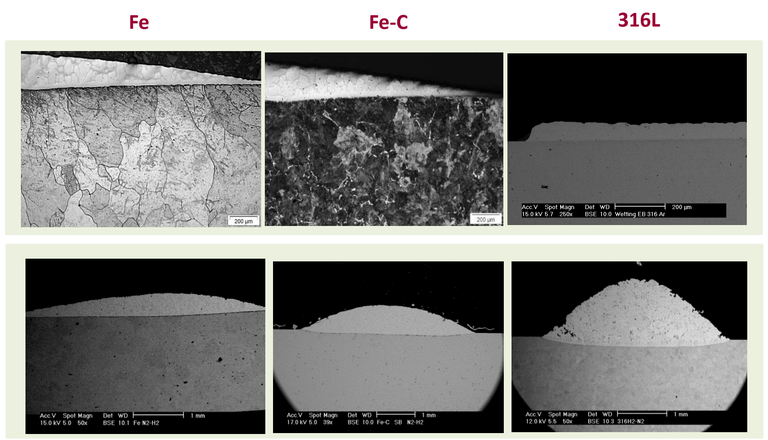


The sintering atmosphere changes the dissolutive character of the system

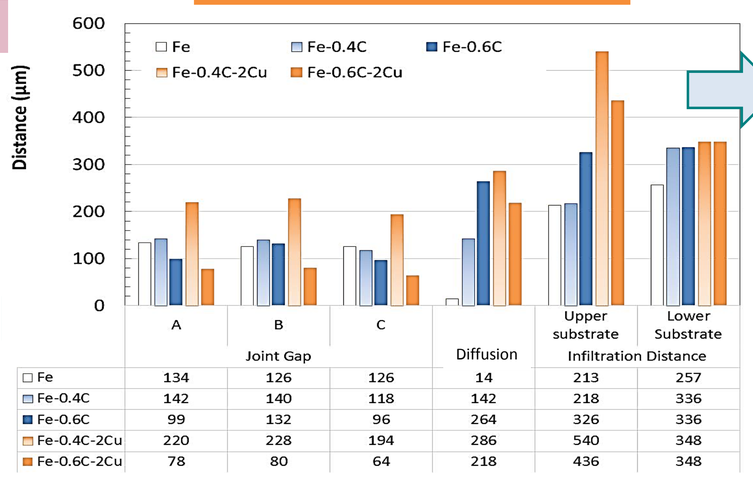
DROP-SUBSTRATE INTERFACE

Ar
Planar interface
Non-reactive wetting and no dissolutive processes

N_2-H_2
Crater formation
Higher Dissolutive processes



LIQUID PHASE (IMAGE ANALYSIS)



	A	B	C	Diffusion	Upper substrate	Lower Substrate
	Joint Gap				Infiltration Distance	
Fe	134	126	126	14	213	257
Fe-0.4C	142	140	118	142	218	336
Fe-0.6C	99	132	96	264	326	336
Fe-0.4C-2Cu	220	228	194	286	540	348
Fe-0.6C-2Cu	78	80	64	218	436	348

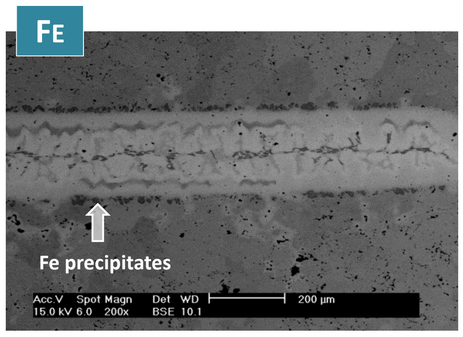
- **Joint width is constant along the gap**
- **C promotes diffusion and infiltration.**
- **↑ %C, gap width is reduced**
- **Cu (2nd liquid phase) affects upper infiltration**

LIQUID VOLUME CONTROL

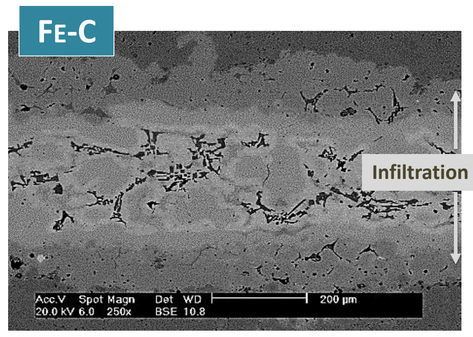
MICROSTRUCTURE OF THE JOINT

Effect of the composition of the base material

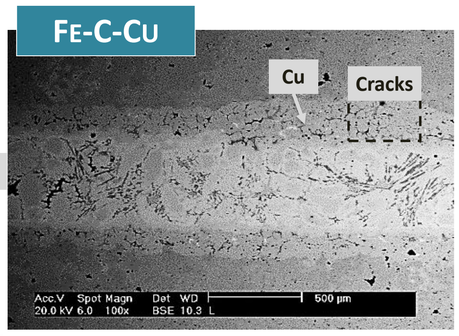
FE

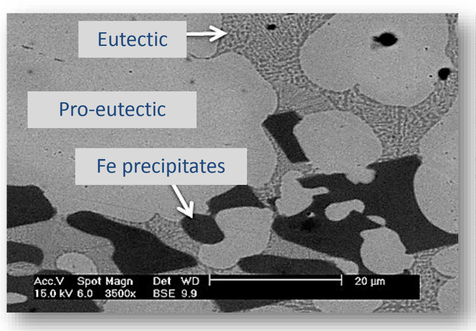


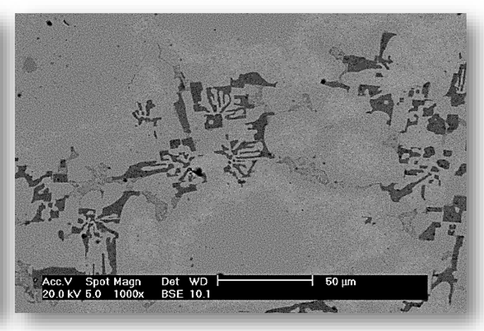
FE-C

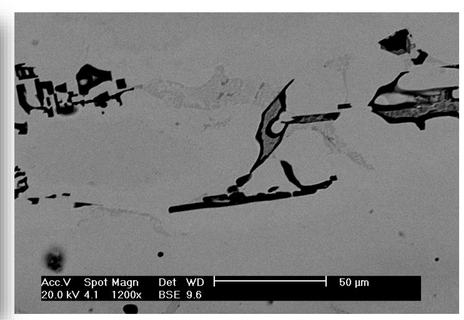


FE-C-CU









FUTURE WORK

4 new designed brazing alloys

Sinter-brazing trials, analysing base material and atmosphere composition
Wetting behaviour of the liquid phase regarding the substrate and atmosphere
Kinetics simulation with Dictra ®

ACKNOWLEDGEMENTS This work has been developed within the international project **Höganäs Chair**