Quenching microstructures of a dual phase stainless steel containing 11%Cr

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I) Bibliographical study

II) Experimental procedure

III) Discussion

Conclusion

Bibliographical study

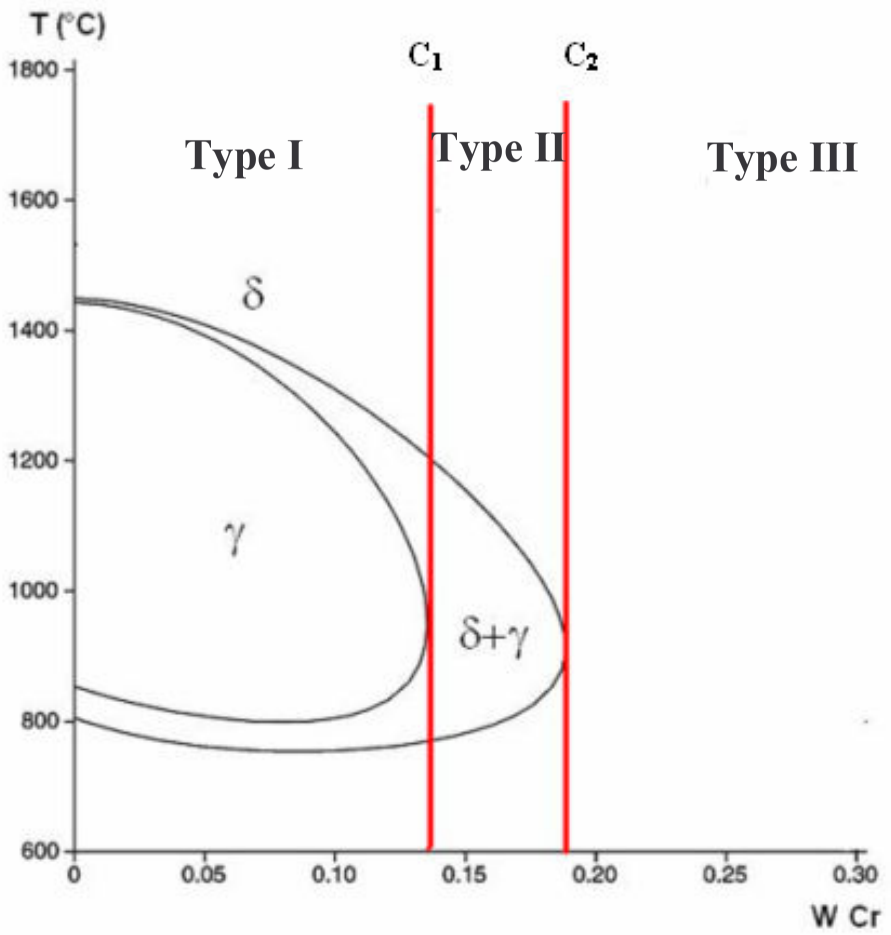
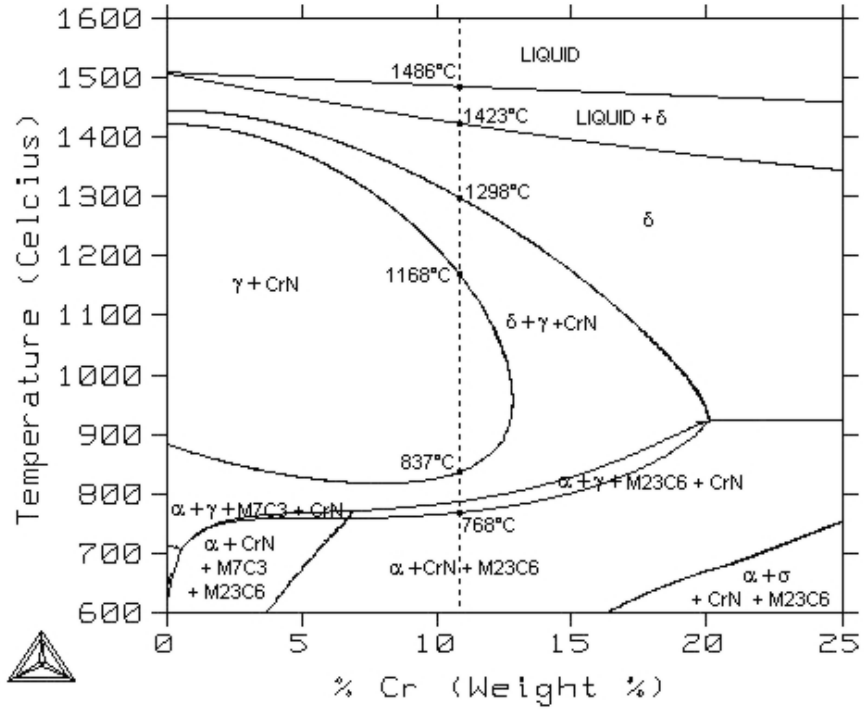


Figure1. Fe-Cr phases diagram (definition of the different types of alloys) **[Lacoude and Goux, 1966]**

material

%Cr	%C	%N	%Ni	%Mn	%Si
10.83	0.0168	0.0133	0.465	0.72	0.47

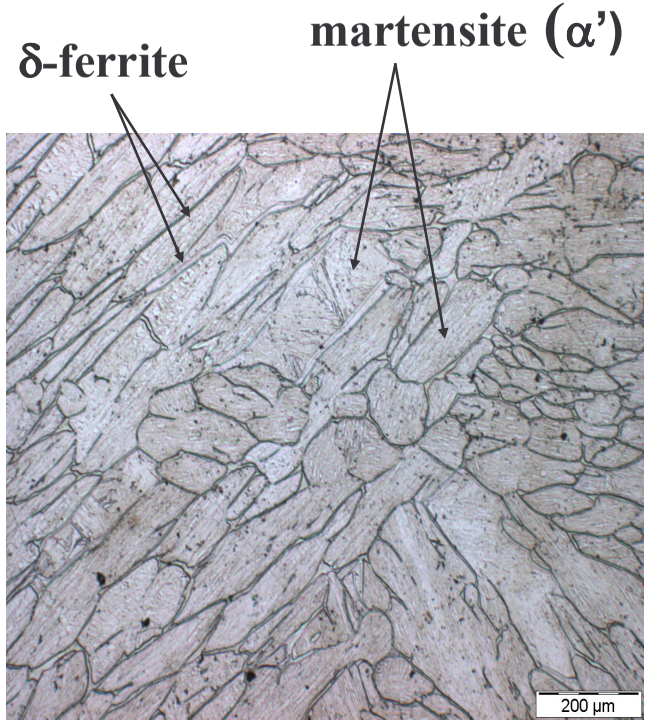
Chemical composition in wt.% of the EN 1.4003



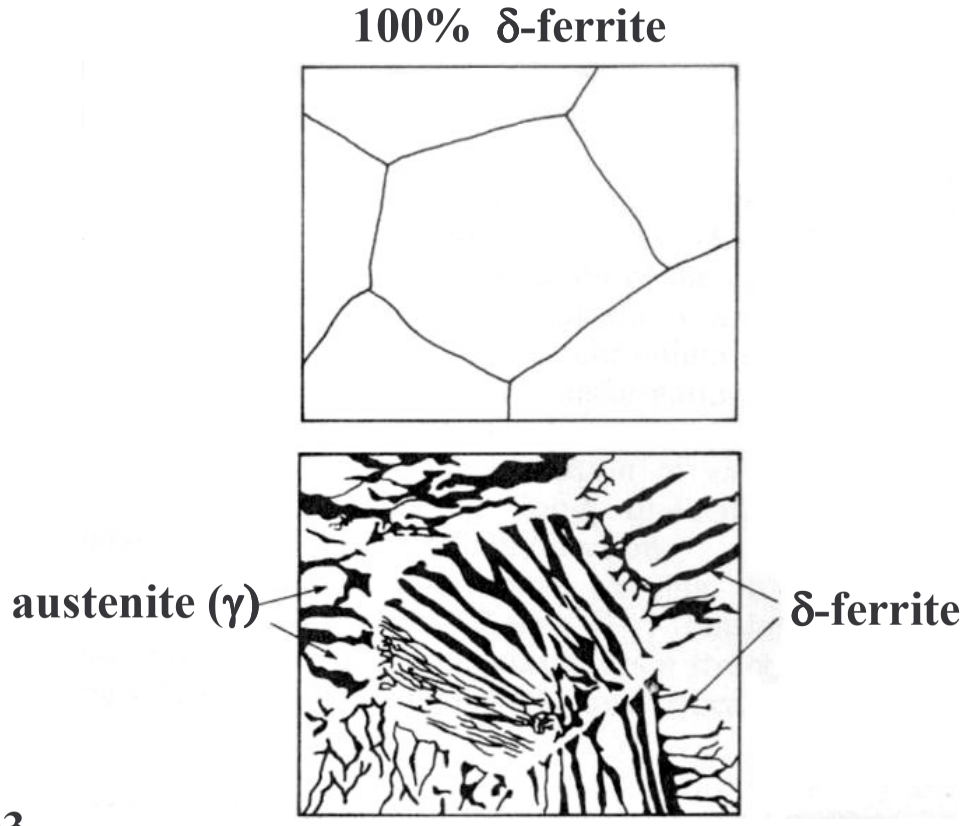
γ loop calculated with ThermoCalc (TCFE database)

Experiments:

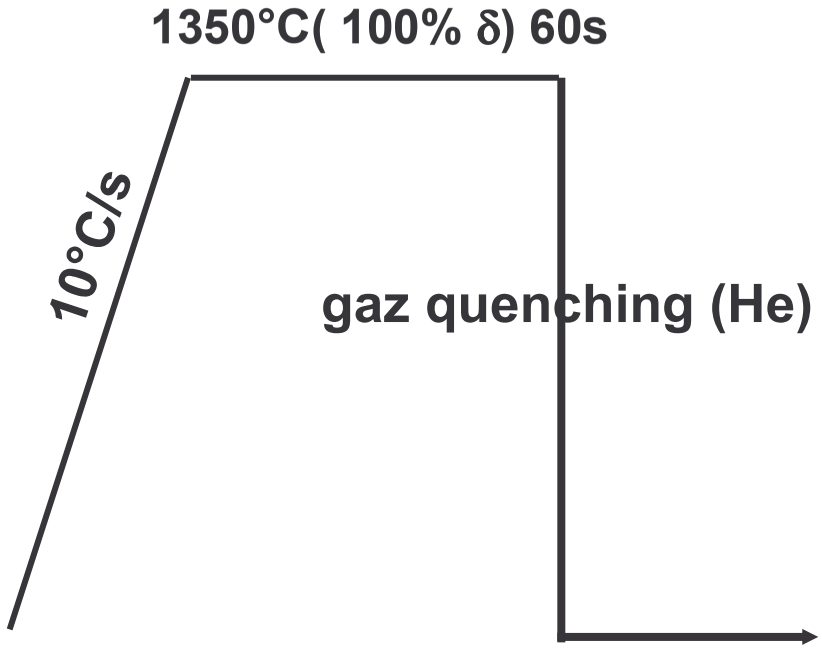
hold at ≠ T in the (γ , δ) phases field (To change f_δ and its morphology) + trempe

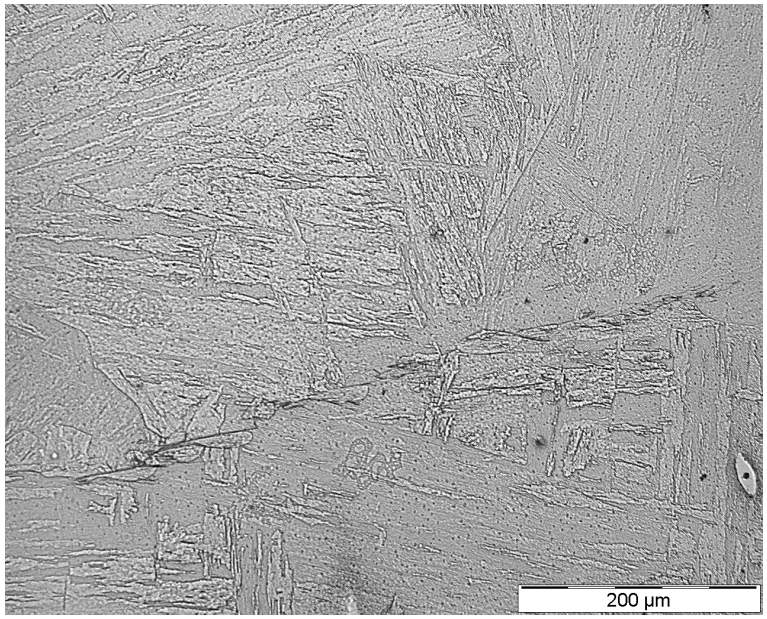


Microstructure of the as-received EN 1.4003



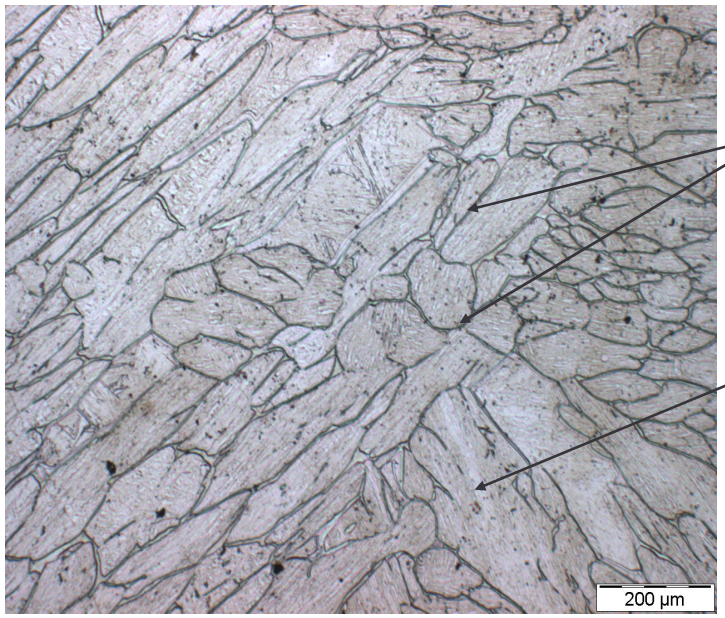
Determination of the type of the as received material





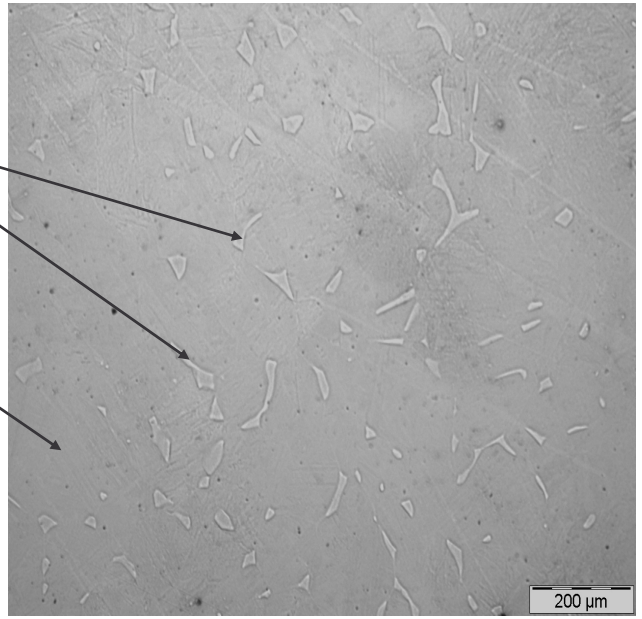
100% martensite microstructure

type I alloy



δ-ferrite

martensite (α')



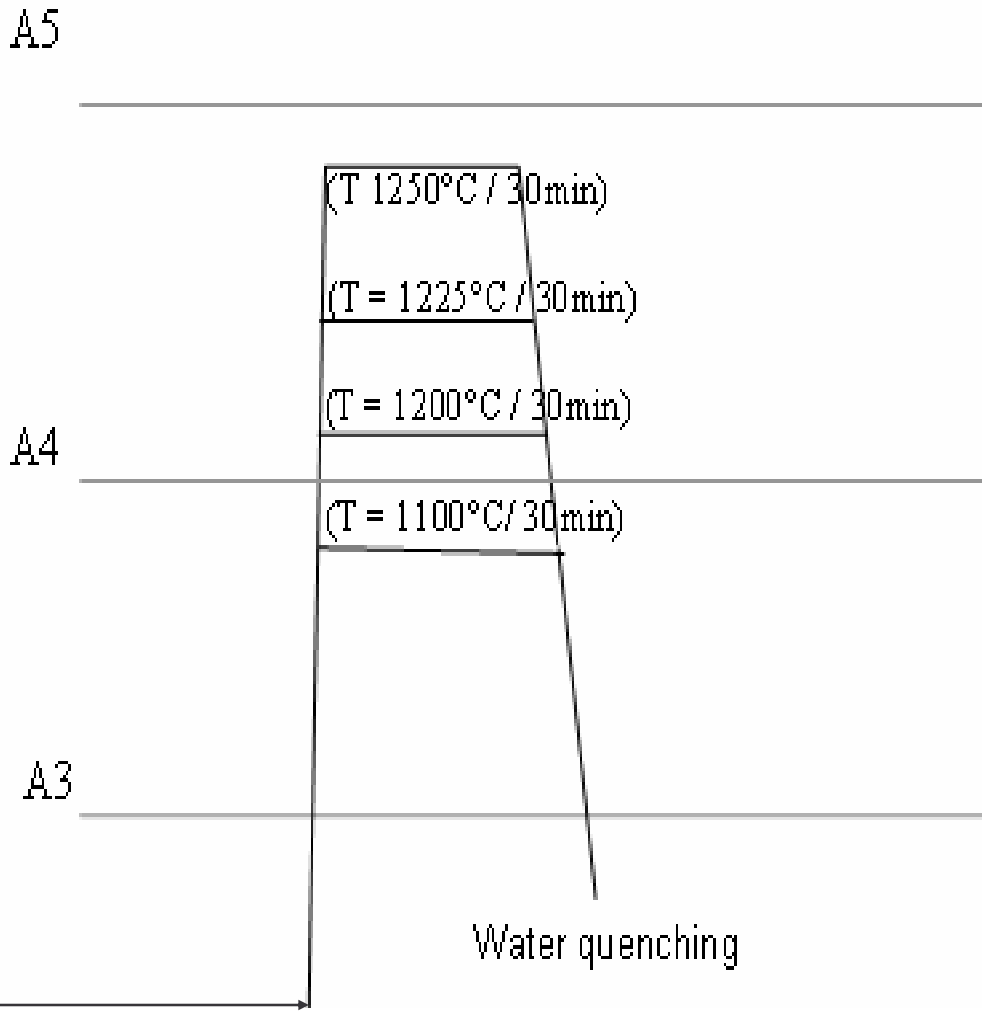
As-received microstructure : starting microstructure of HT1

The microstructure after 66h Homogenisation at 1150°C: starting microstructure of HT2

The initial microstructures for the heat treatments HT1 and HT2

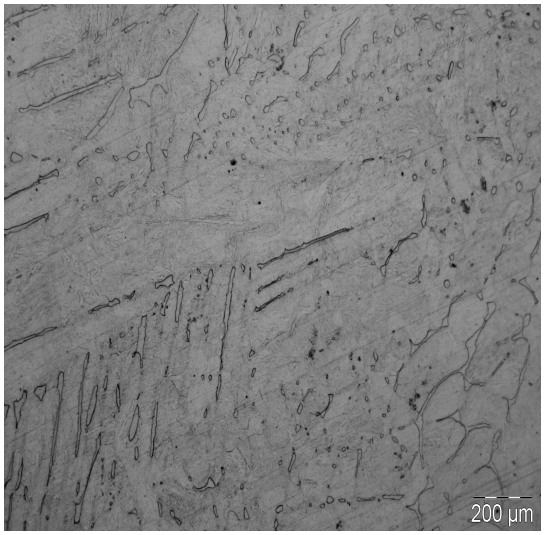
HT1

As-received microstructure

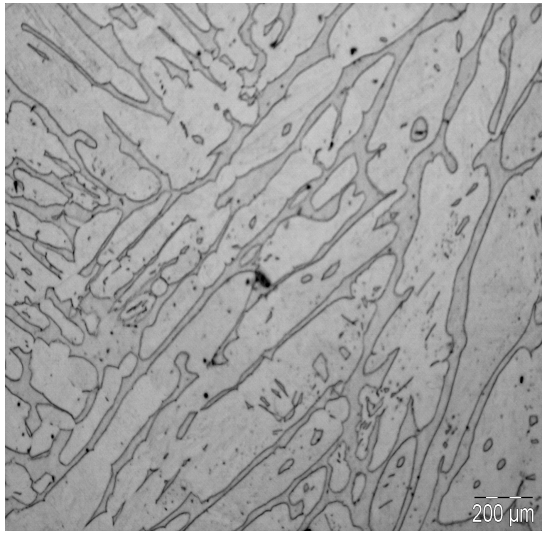


T = 1100°C , 1200°C, 1225°C, t = 30 min

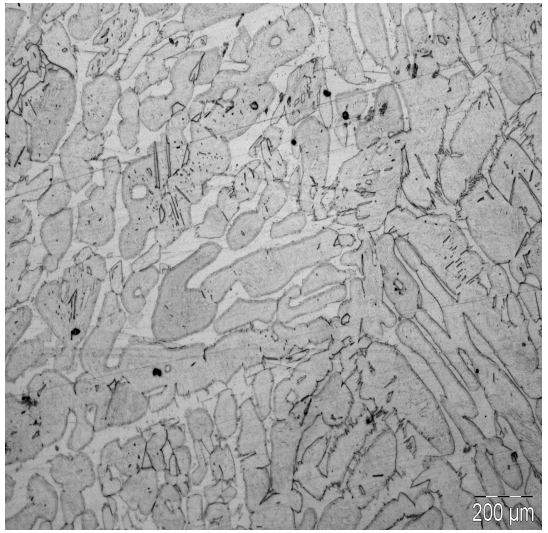
f_δ ↗



T = 1100°C



T = 1200°C

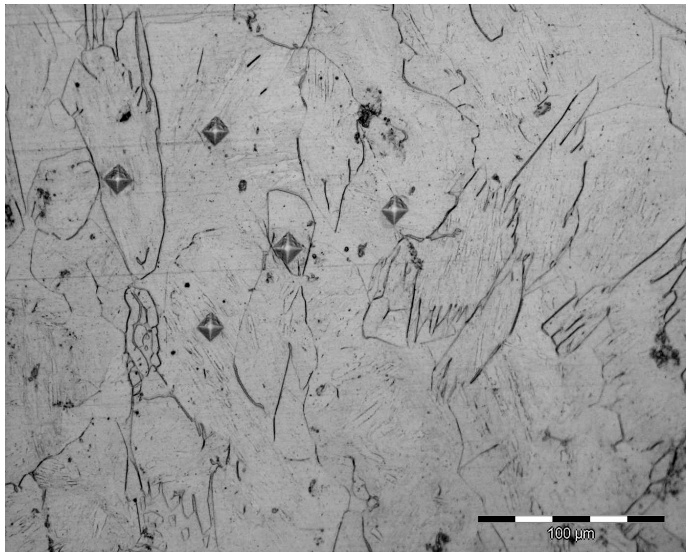


T = 1225°C

Evolution of the microstructure with annealing temperature (HT1)

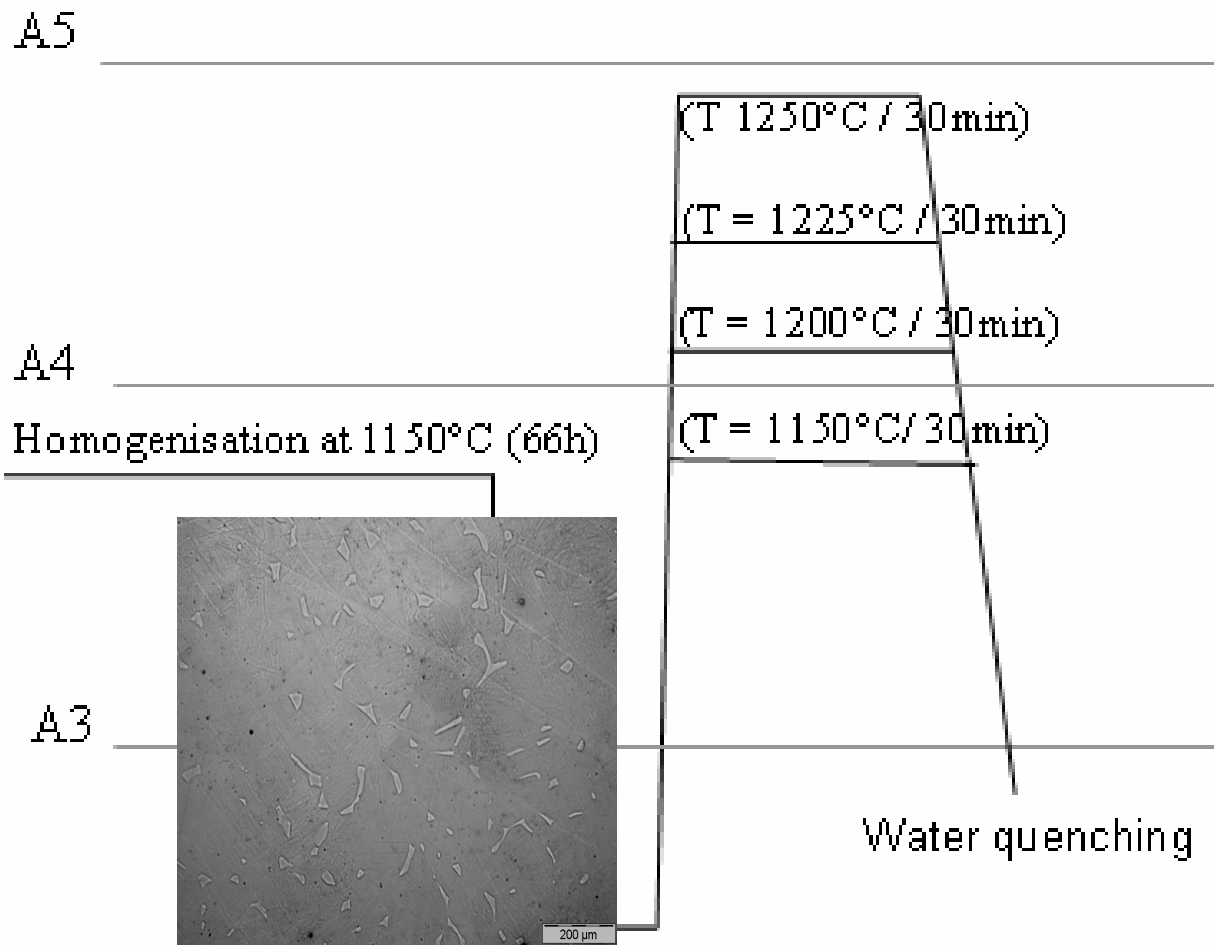
T = 1250°C

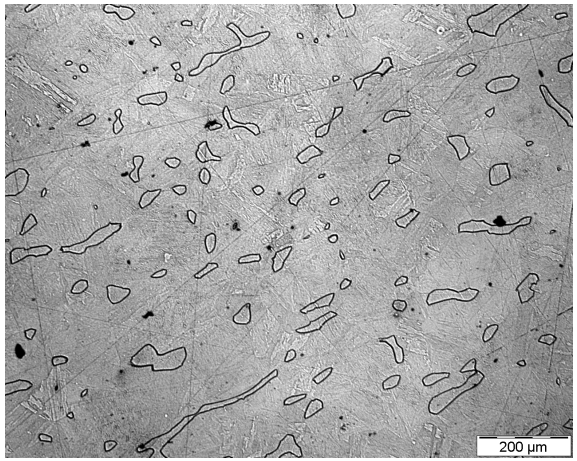
f_δ ↗



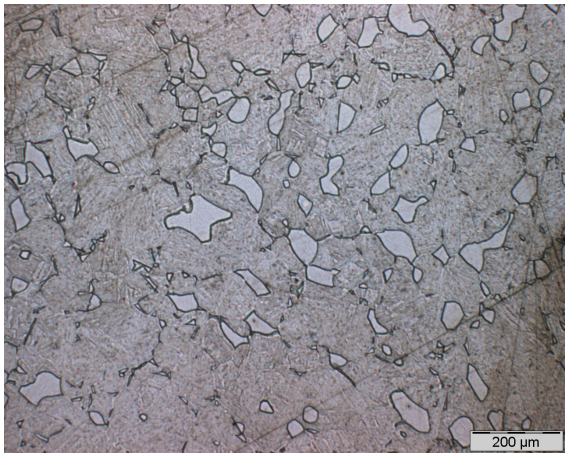
HT2


200 µm

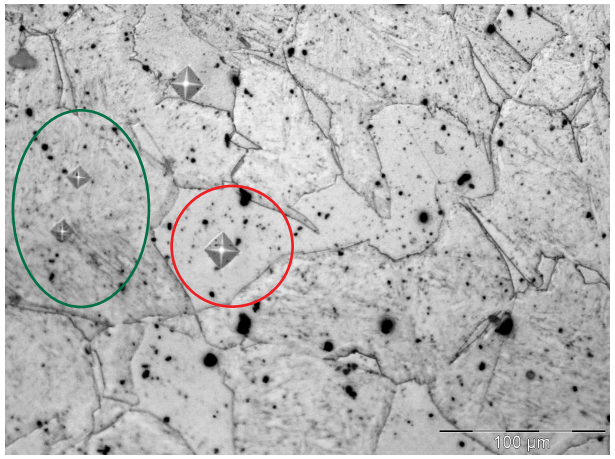

A5
(T 1250°C / 30min)
(T = 1225°C / 30min)
(T = 1200°C / 30min)
A4
Homogenisation at 1150°C (66h)
(T = 1150°C/ 30min)
A3
Water quenching
200 µm



T= 1150°C



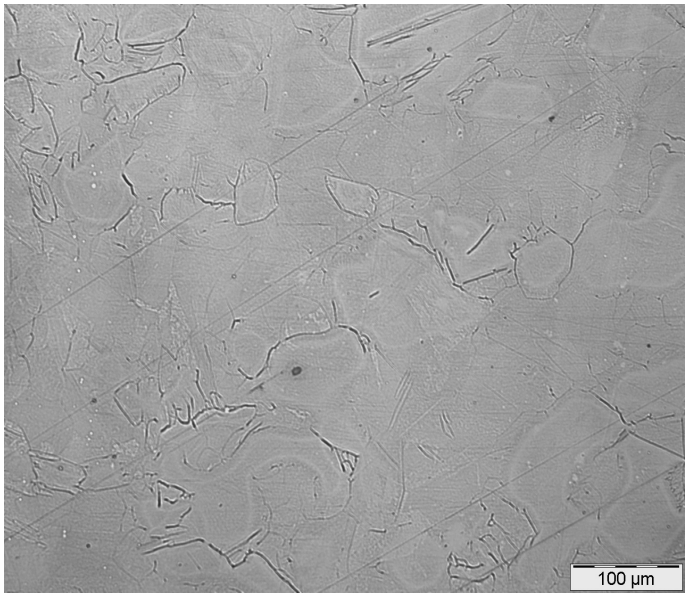
T = 1200°C

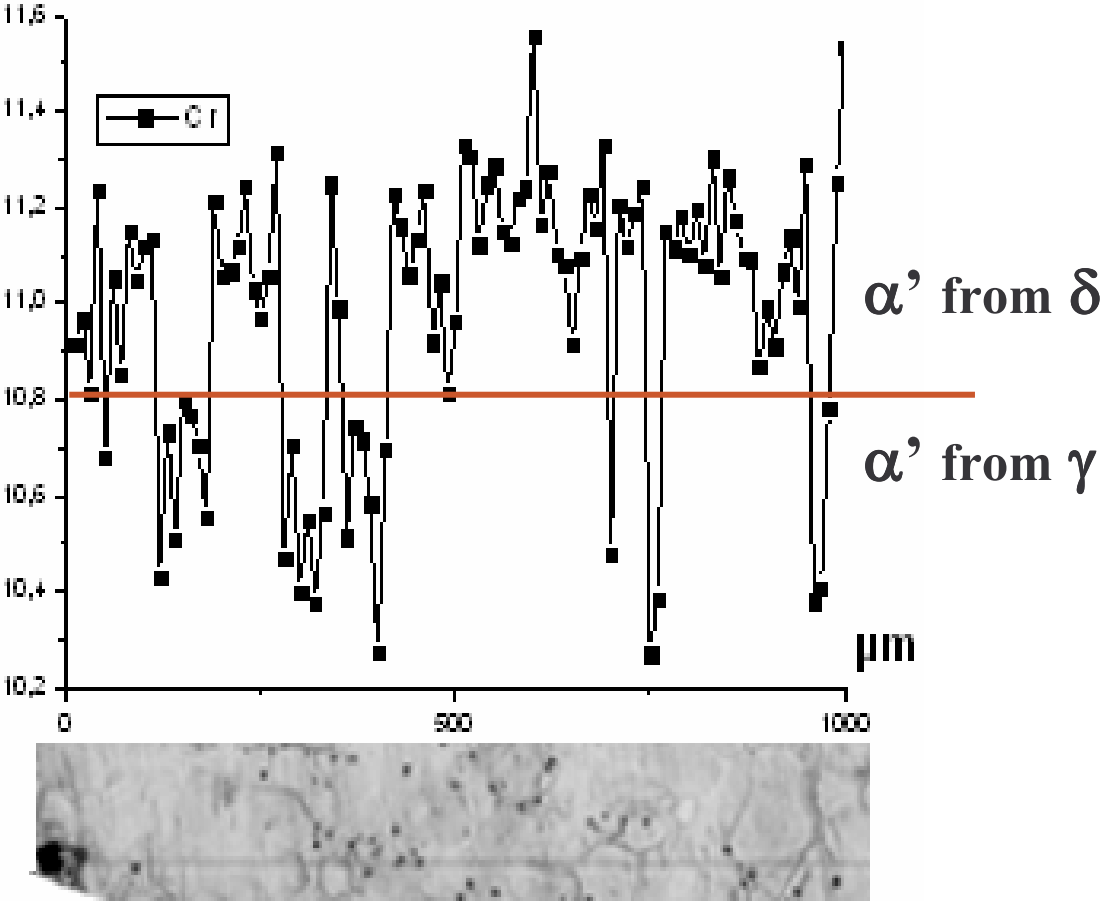


T = 1225°C

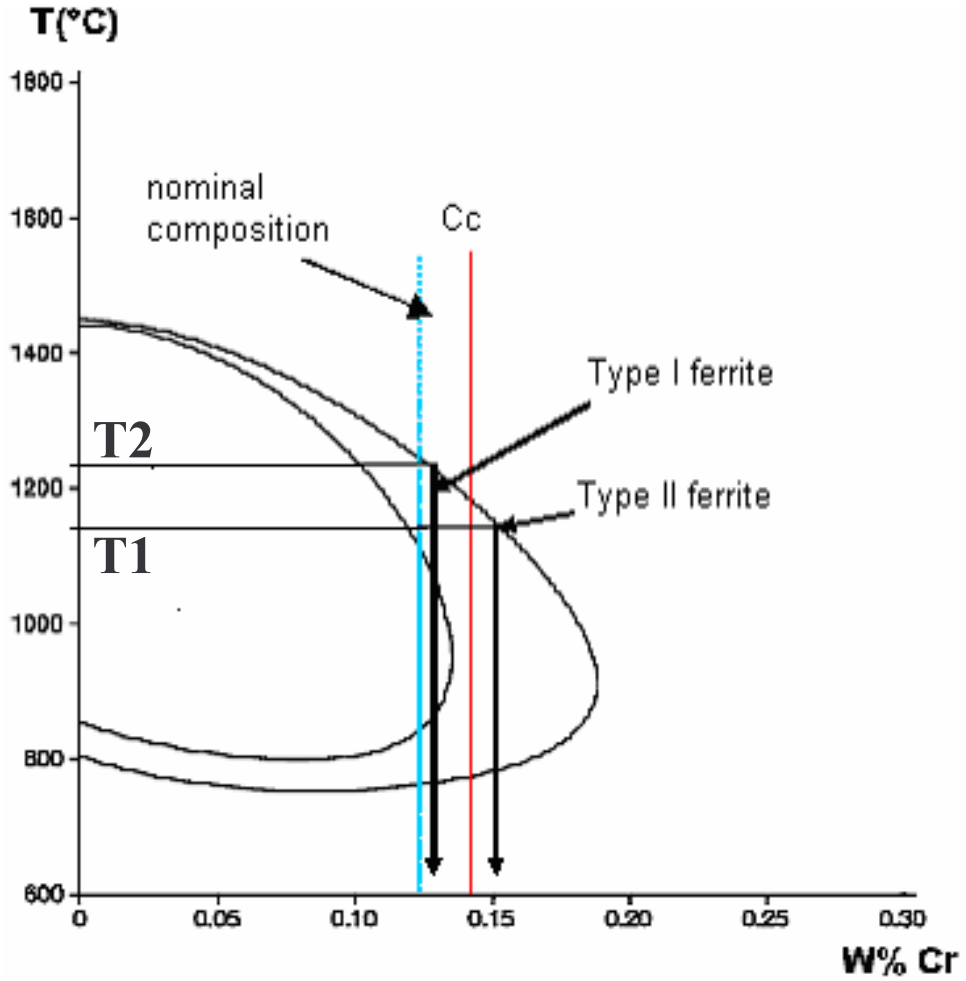
Evolution of the microstructure with annealing temperature (HT2)

T = 1250°C


100 µm

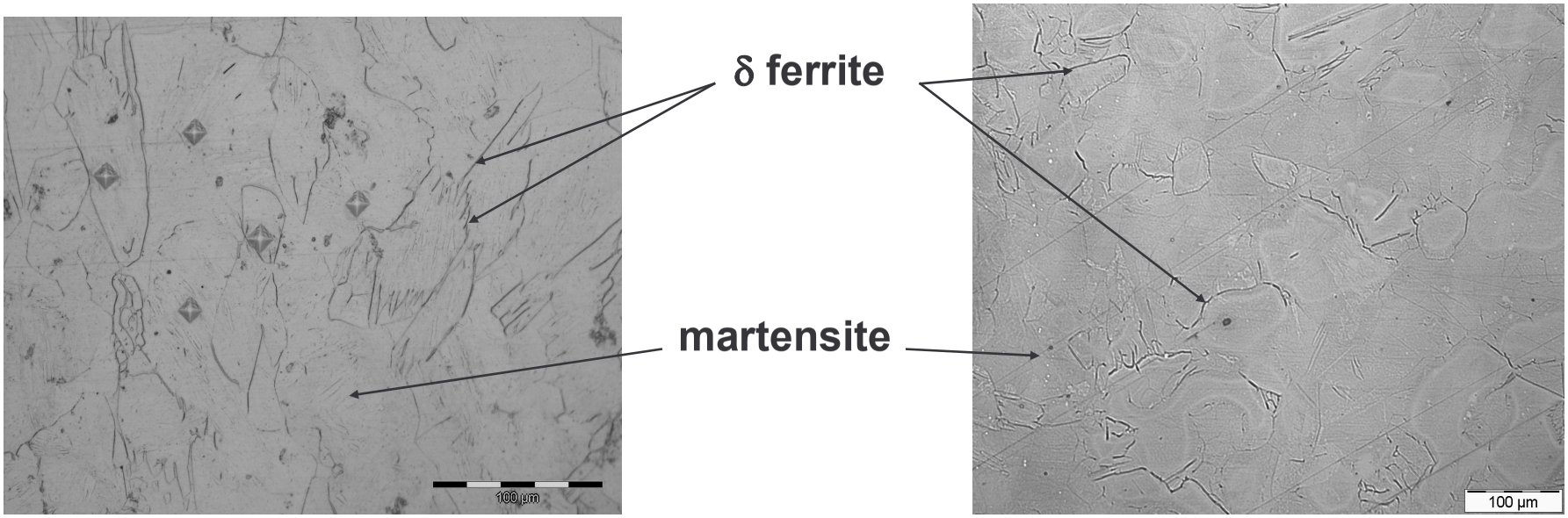

Cr
11,6
11,4
11,2
11,0
10,8
10,6
10,4
10,2
0
500
1000
α' from δ
α' from γ
µm

Discussion


T(°C)
1800
1600
1400
1200
1000
800
600
nominal
composition
Cc
Type I ferrite
Type II ferrite
T2
T1
0
0.05
0.10
0.15
0.20
0.25
0.30
W% Cr

Orgin of the residual layer of δ ferrite

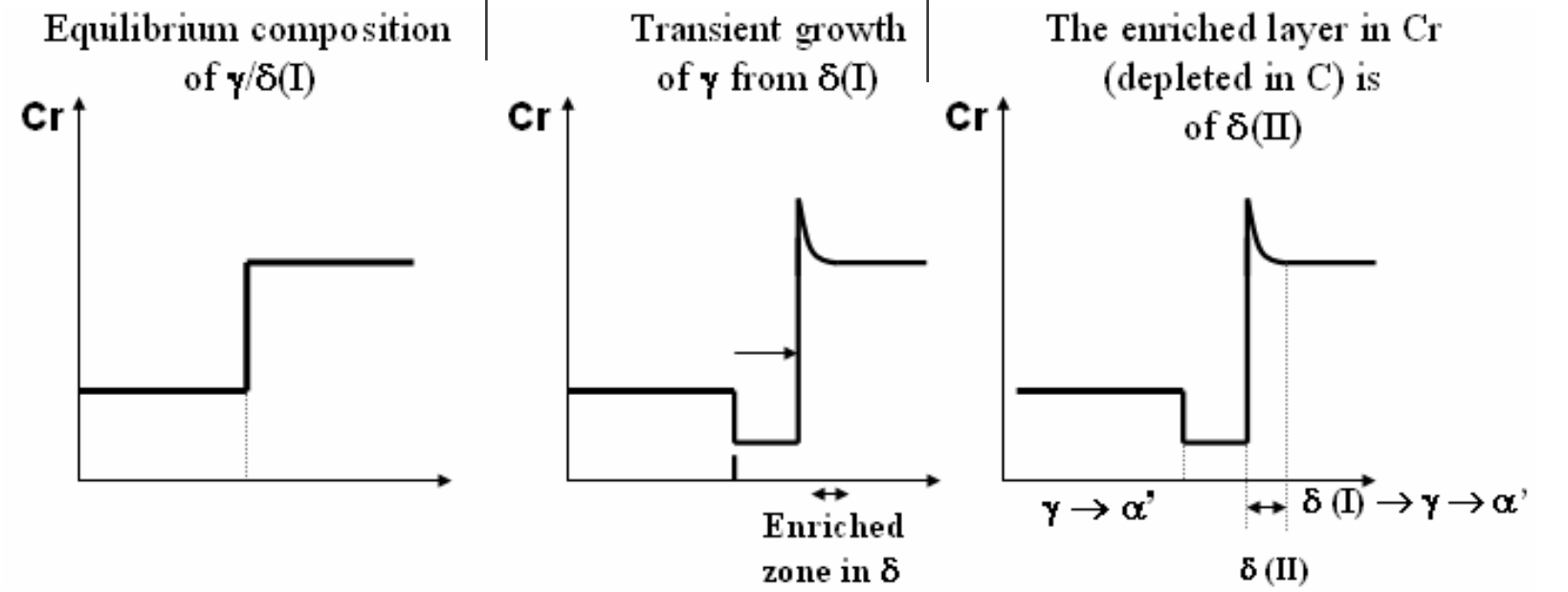
T = 1250°C

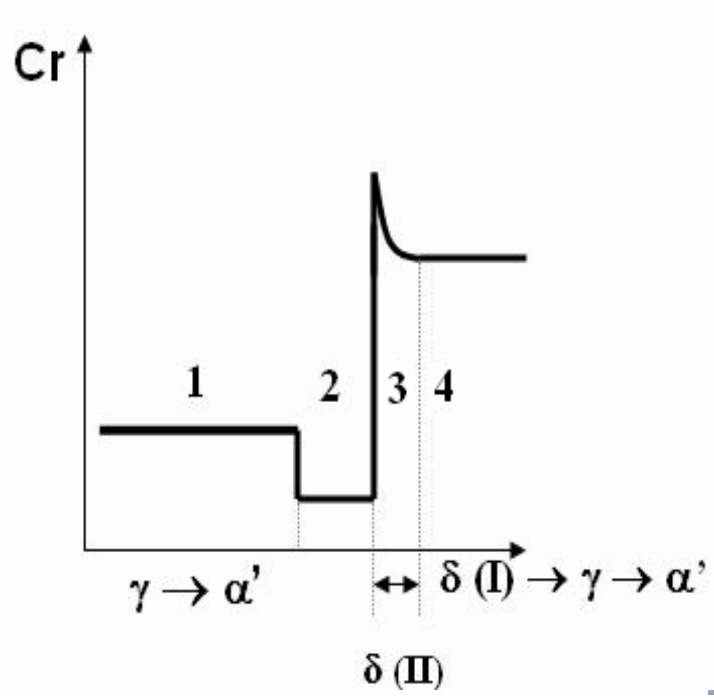


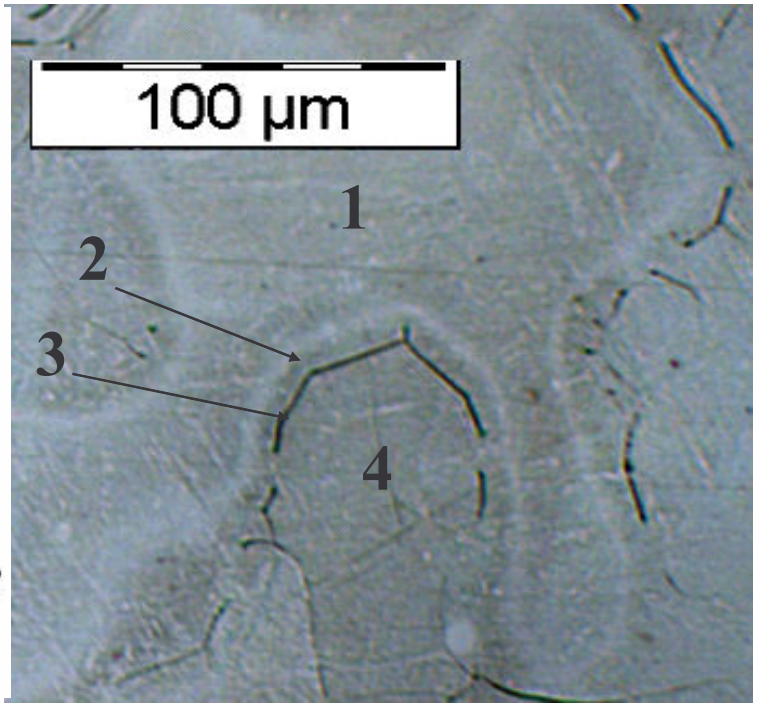
HT1

HT2

Heat treatment	Transient cooling	Quenching

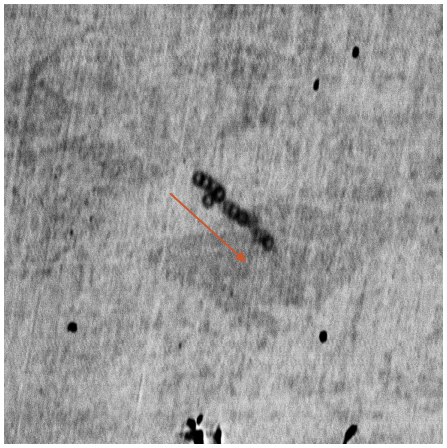




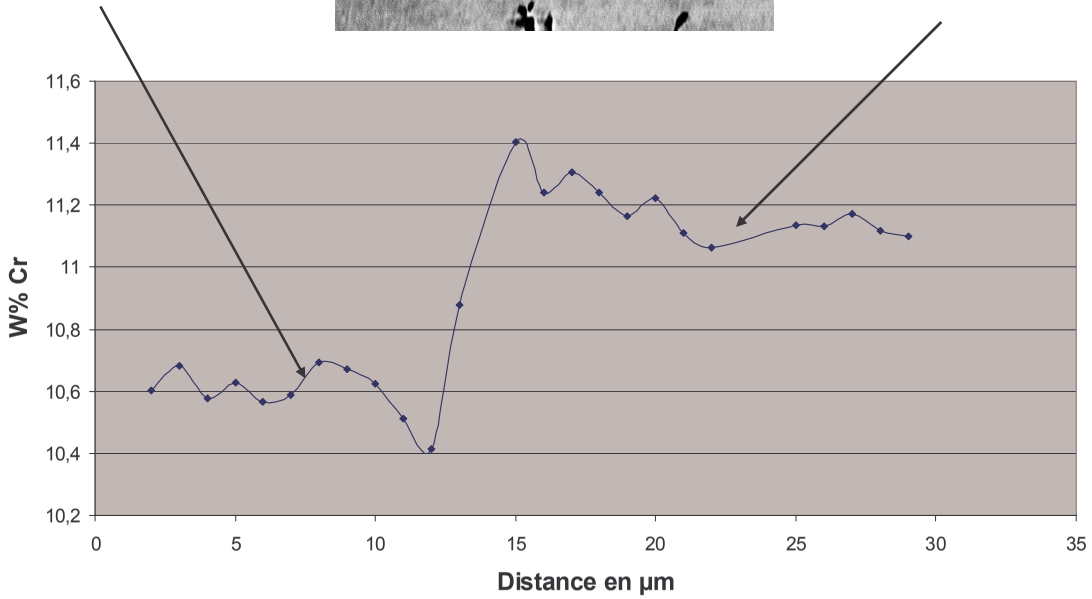


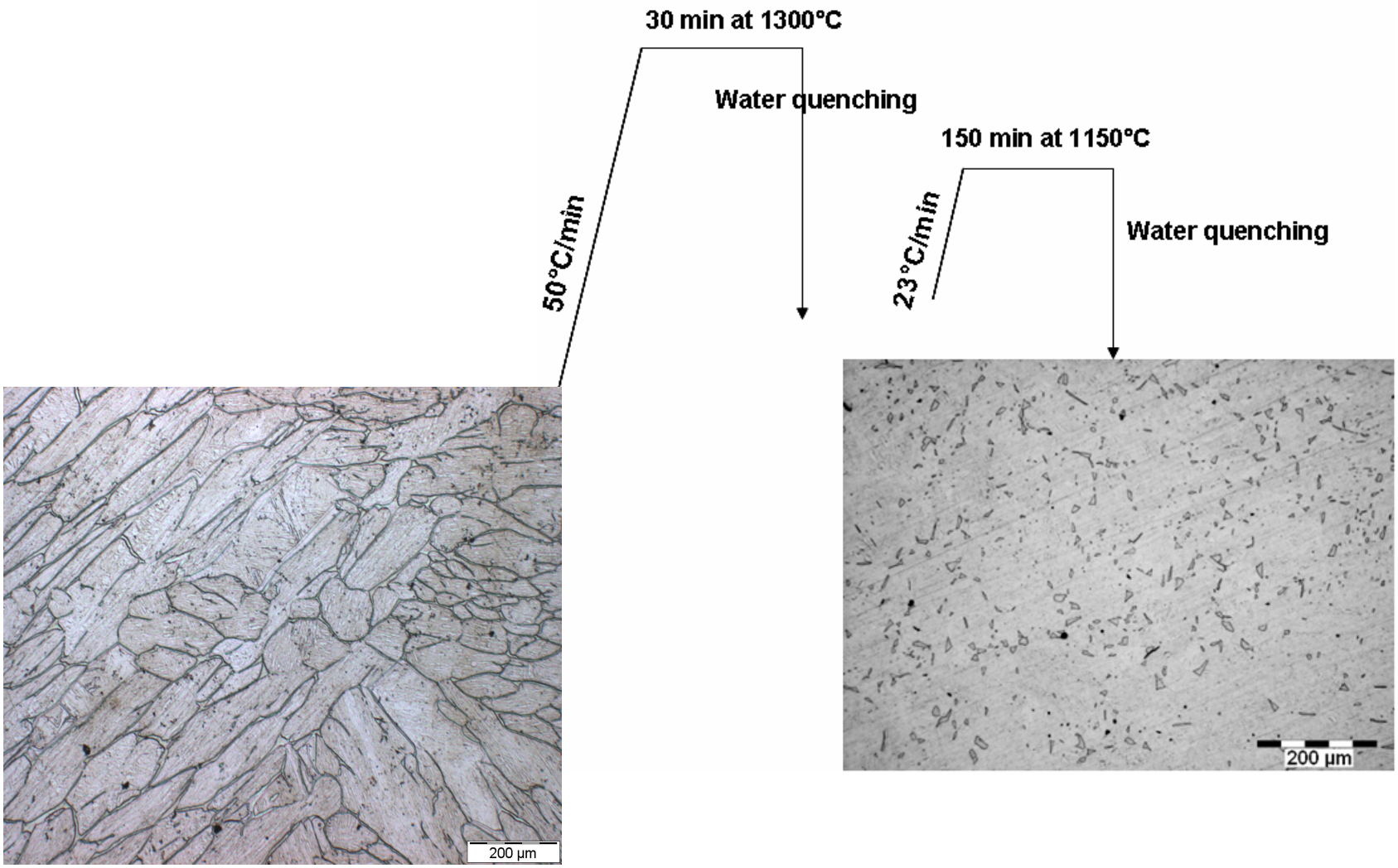
The four zone's microstructure

α' from γ



α' from δ




30 min at 1300°C
Water quenching
150 min at 1150°C
50°C/min
23°C/min
Water quenching
200 µm
200 µm

Conclusions