Evolution of lattice mismatch in modified $Al_{10}Co_{25}Cr_8Fe_{15}Ni_{36}Ti_6$ compositionally complex alloy

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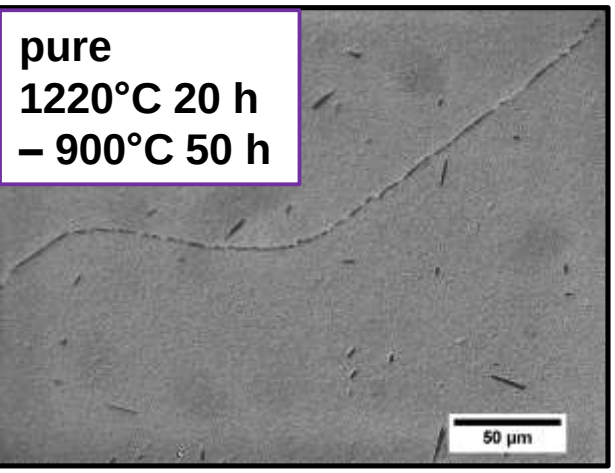
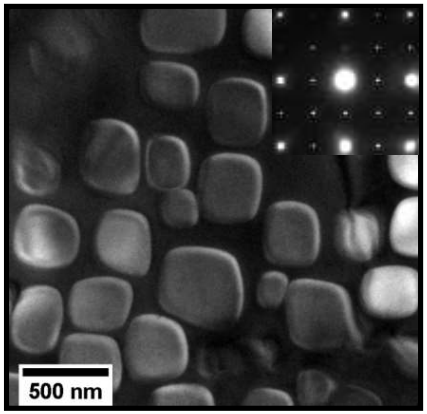
Overview over the microstructure



The γ- γ' morphology



Pure
$Al_{10}Co_{25}Cr_8Fe_{15}Ni_{36}Ti_6$
Ann 900°C 50 h

Mixing enthalpies / atomic radii

Takeuchi et al., Materials Transactions 46(2005)

The values of heat of mixing are quoted as enthalpy of mixing $\Delta H^{mix}_{\{AB\}}$ of the binary liquid in an A–B system at an equiatomic composition.

B\A	Al	Co	Cr	Fe	Ni	Ti
Mo	-5	-5	0	-2	-7	-4
Zr	***-44***	-41	-12	-25	***-49***	0
Hf	***-39***	-35	-9	-21	***-42***	0
B	0	-24	***-31***	-26	-24	***-58***

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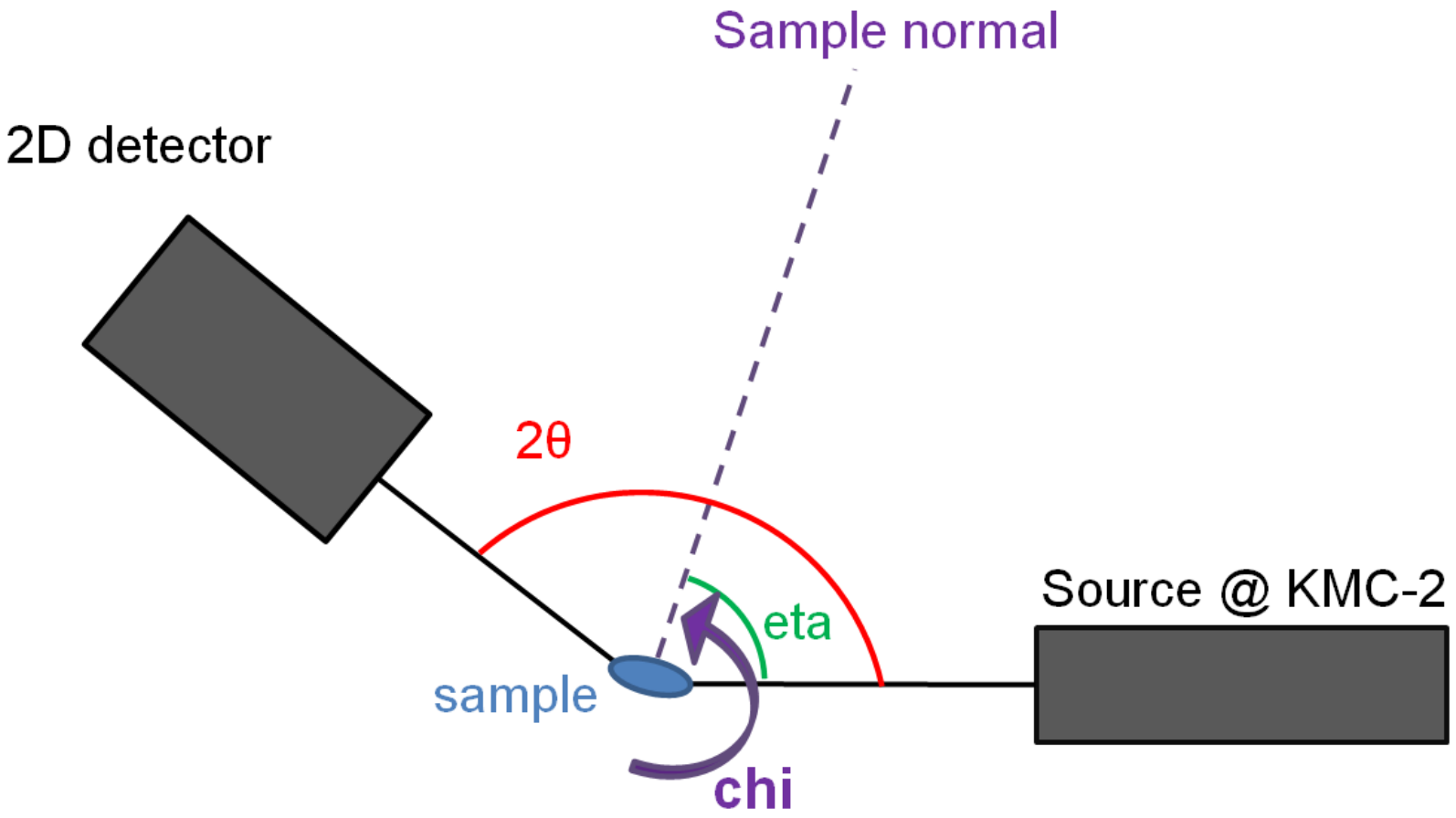
Experiment setup at KMC-2



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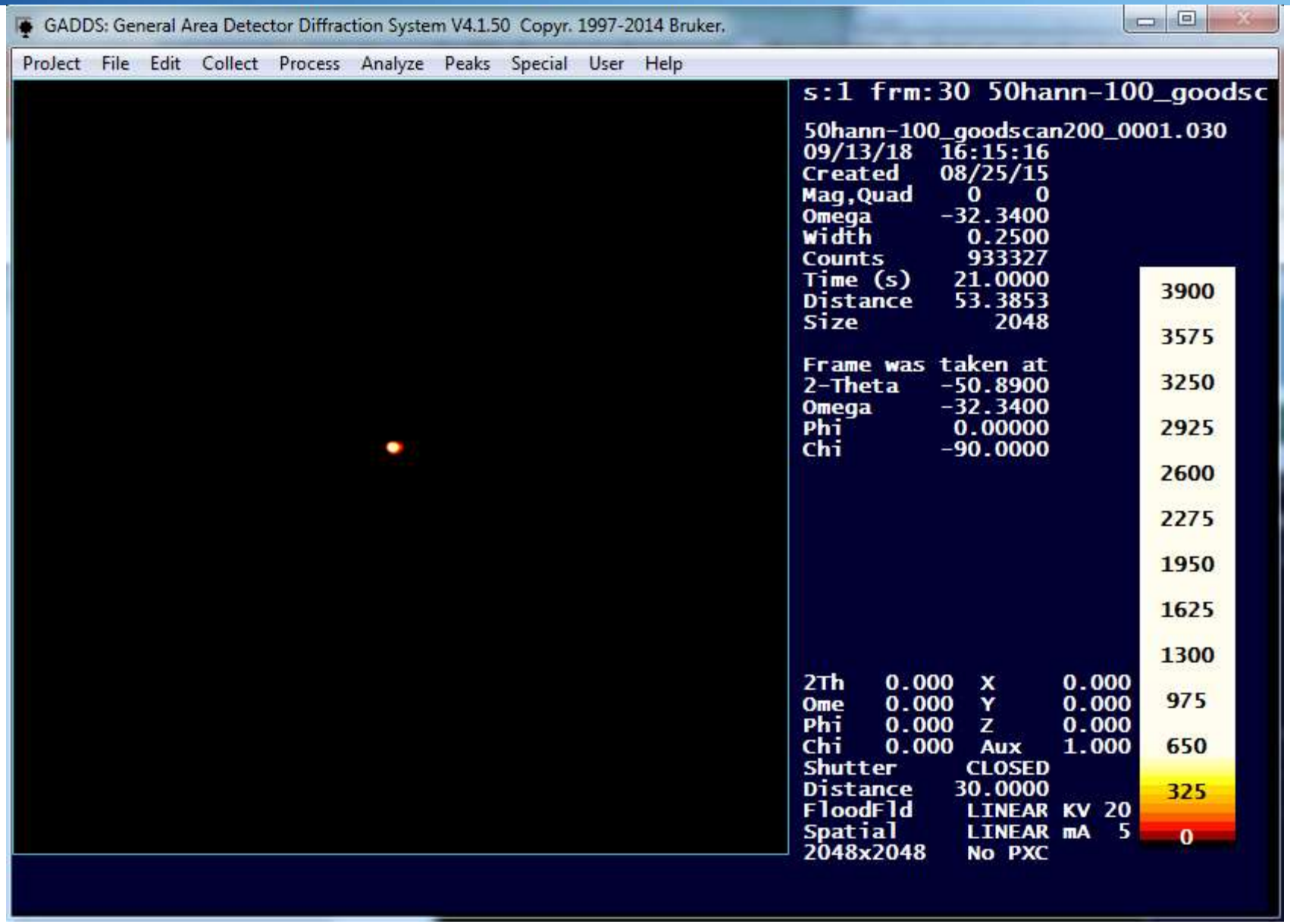
Setup of the 3D-detector



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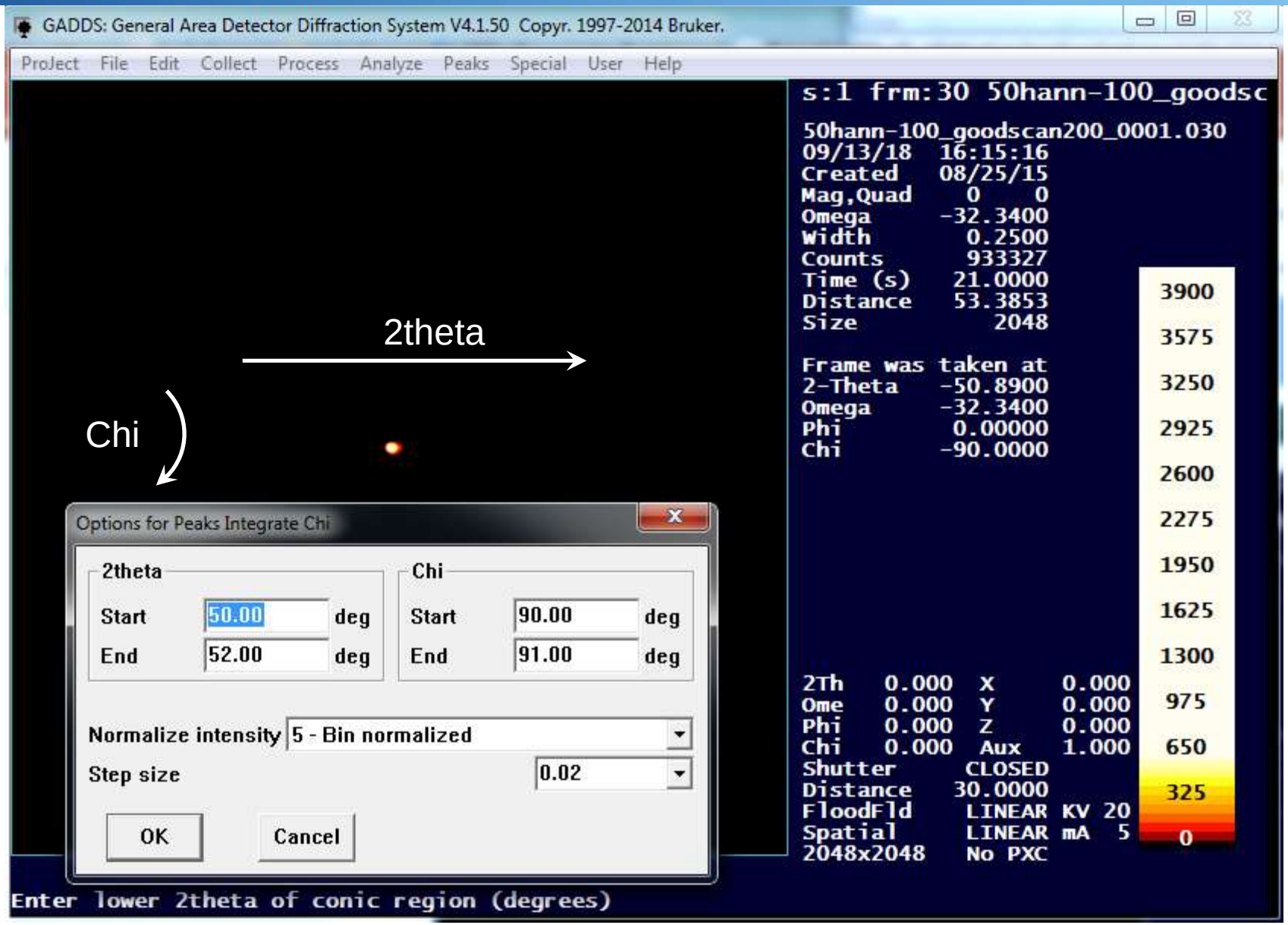

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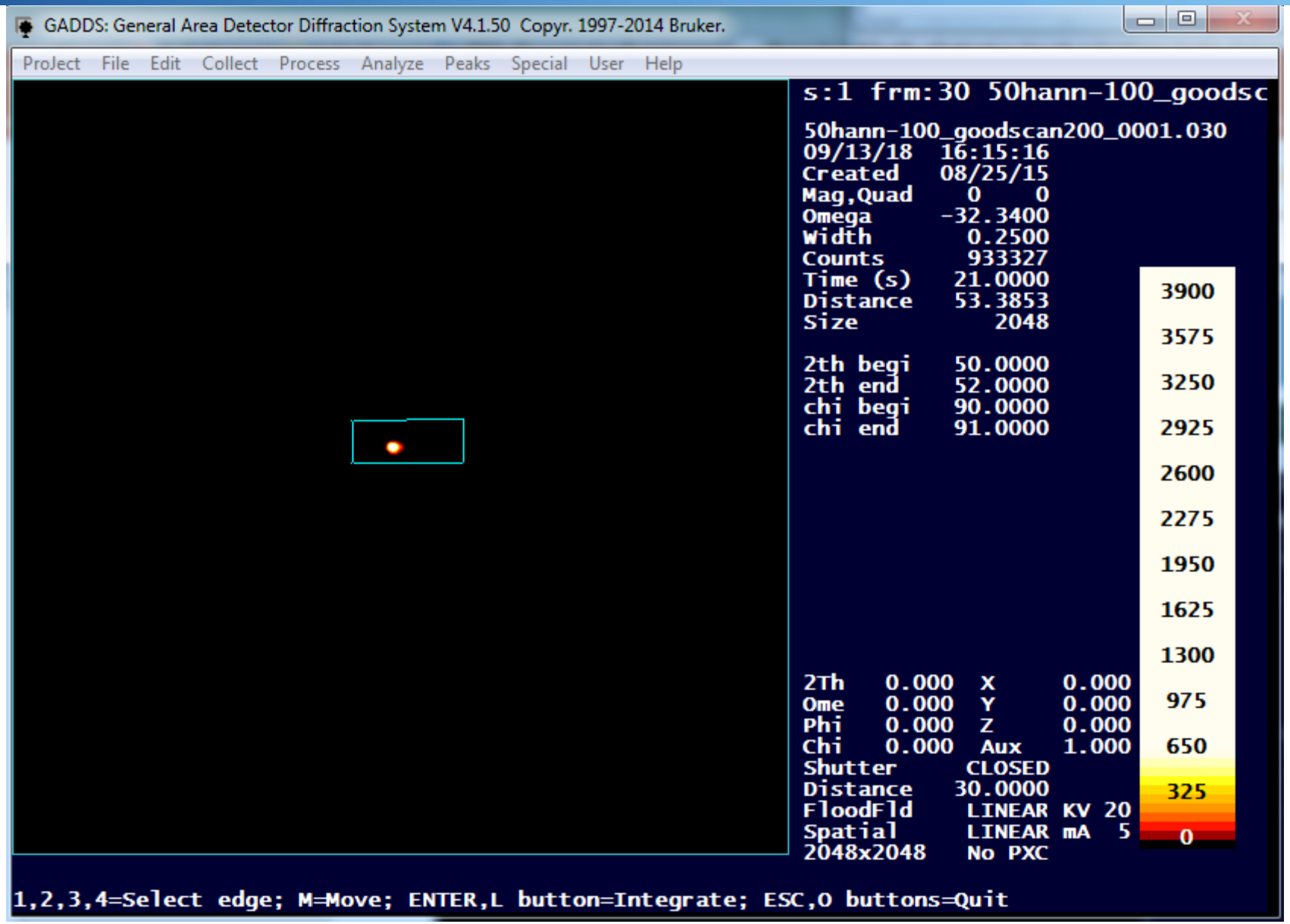

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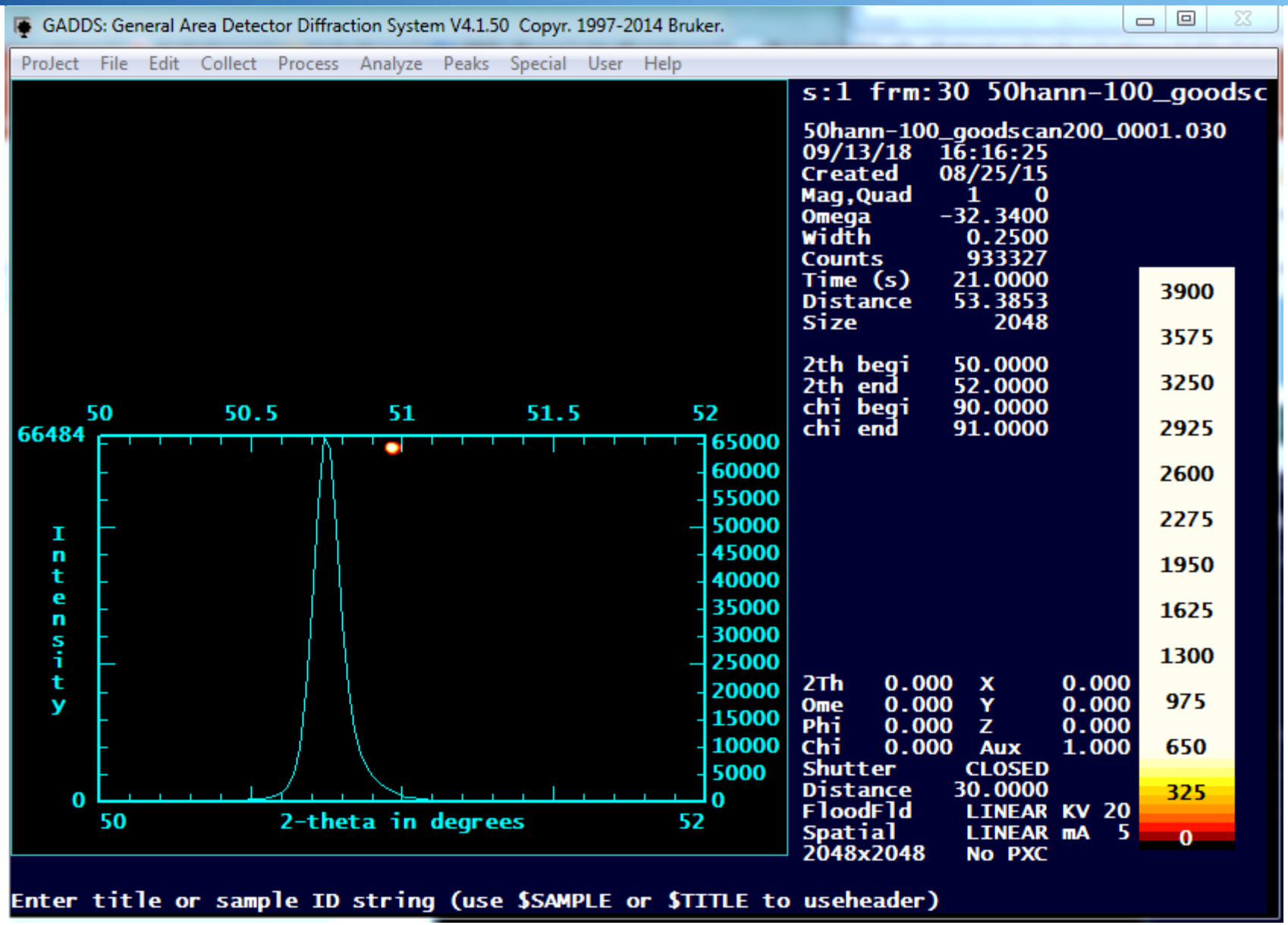

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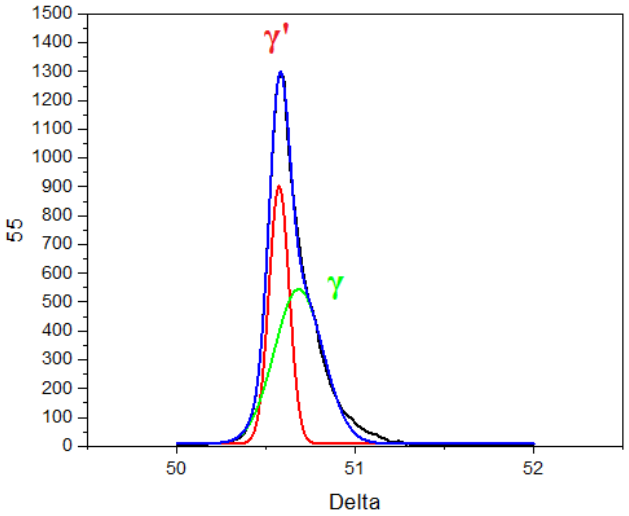
Peak shapes – evolution over Chi



Model	Gauss	
Equation	y=y0 + (A/(w*sqrt(pi/2)))*exp(-2*((x-xc)/w)^2)	
Plot	Peak1(55)	Peak2(55)
y0	9.25623 ± 1.92907	9.25623 ± 1.92907
xc	50.57346 ± 8.25103E-	50.68303 ± 0.00449
w	0.11264 ± 0.00233	0.27111 ± 0.00467
A	126.14238 ± 4.93656	182.00213 ± 5.8994
Reduced Chi-Sqr	233.77843	
R-Square(COD)	0.99776	
Adj. R-Square	0.99762	

Example Alloy-B0,5 – (200) 200°C

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Three peaks?

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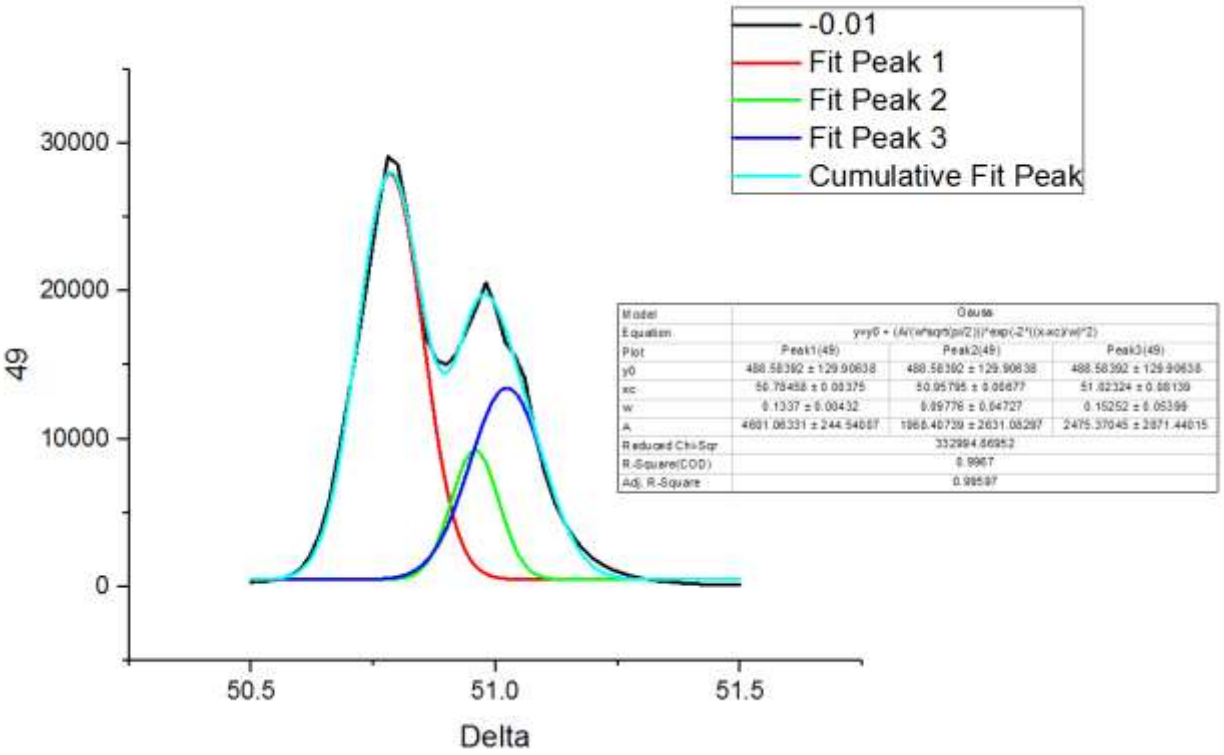
Three peaks?



Model	Gauss		
Equation	y=y0 + (A/(w*sqrt(pi/2)))*exp(-2*((x-xc)/w)^2)		
Plot	Peak1(49)	Peak2(49)	Peak3(49)
y0	488.58392 ± 129.90638	488.58392 ± 129.90638	488.58392 ± 129.90638
xc	50.78468 ± 0.00375	50.95795 ± 0.00677	51.02324 ± 0.00139
w	0.1337 ± 0.00432	0.09776 ± 0.04727	0.15252 ± 0.05396
A	4601.08331 ± 244.54087	1868.40739 ± 2631.08287	2475.37045 ± 2871.44015
Reduced Chi-Sqr	352994.66952		
R-Square(COD)	0.9967		
Adj. R-Square	0.99597		

Base alloy, Peak (200), room temperture

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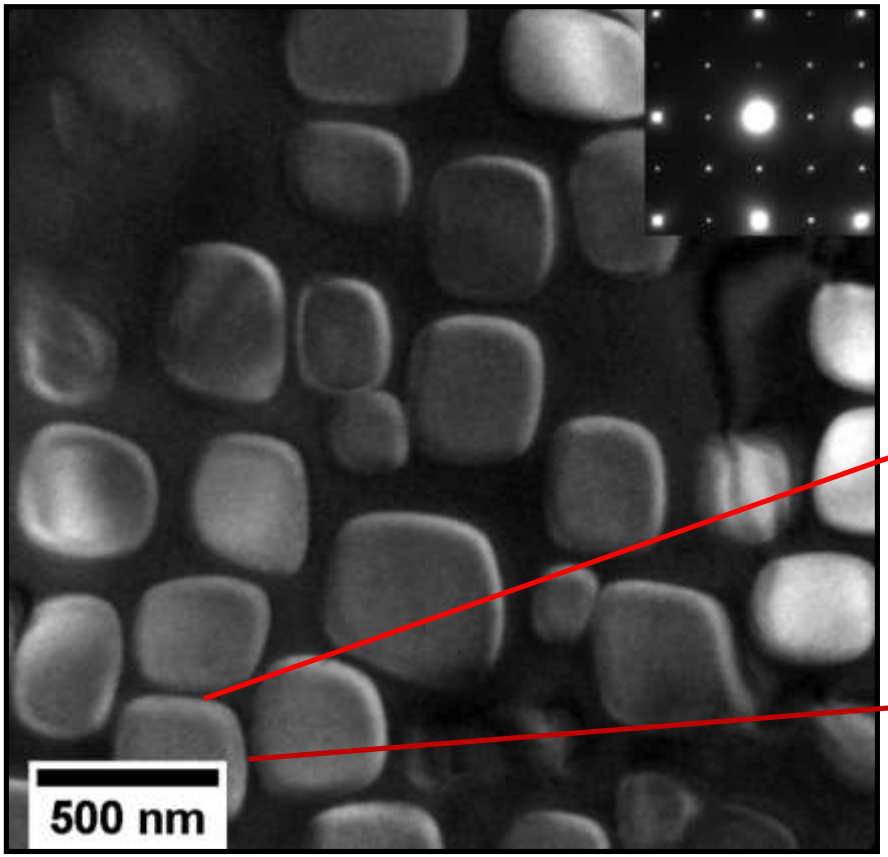
Three peaks?



γ_1

γ_2

Base alloy, Peak (200), room temperture

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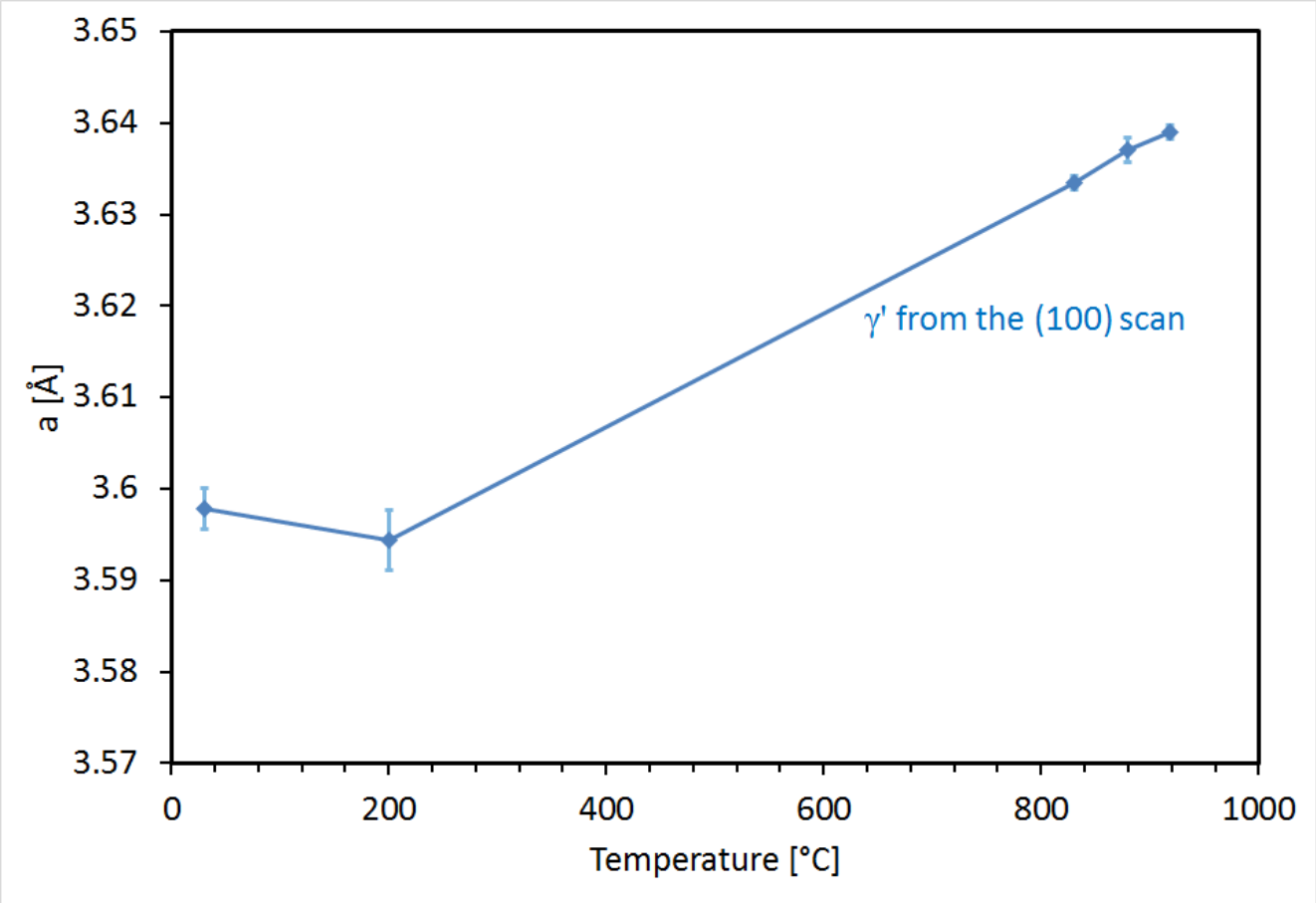
Difficulties



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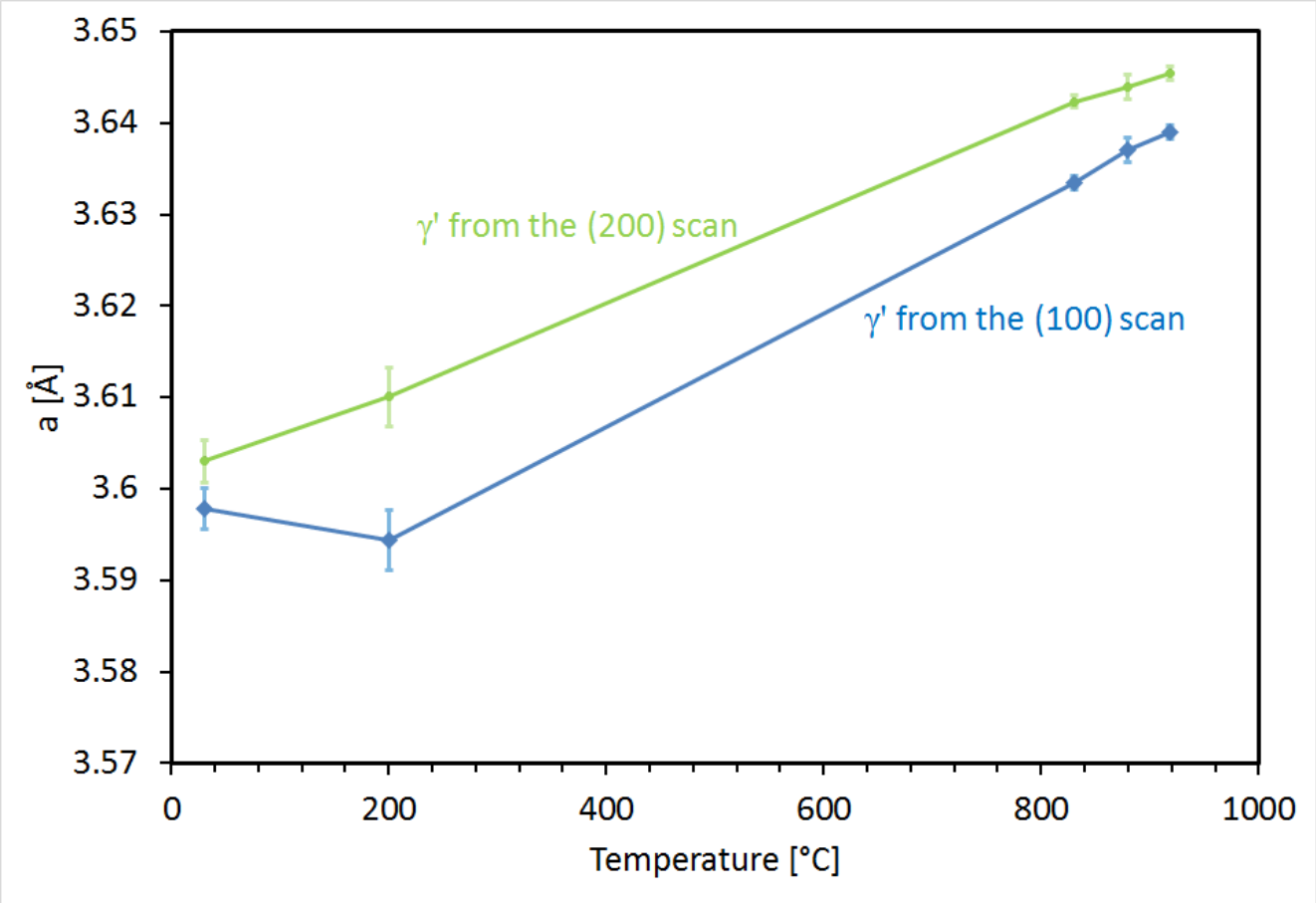

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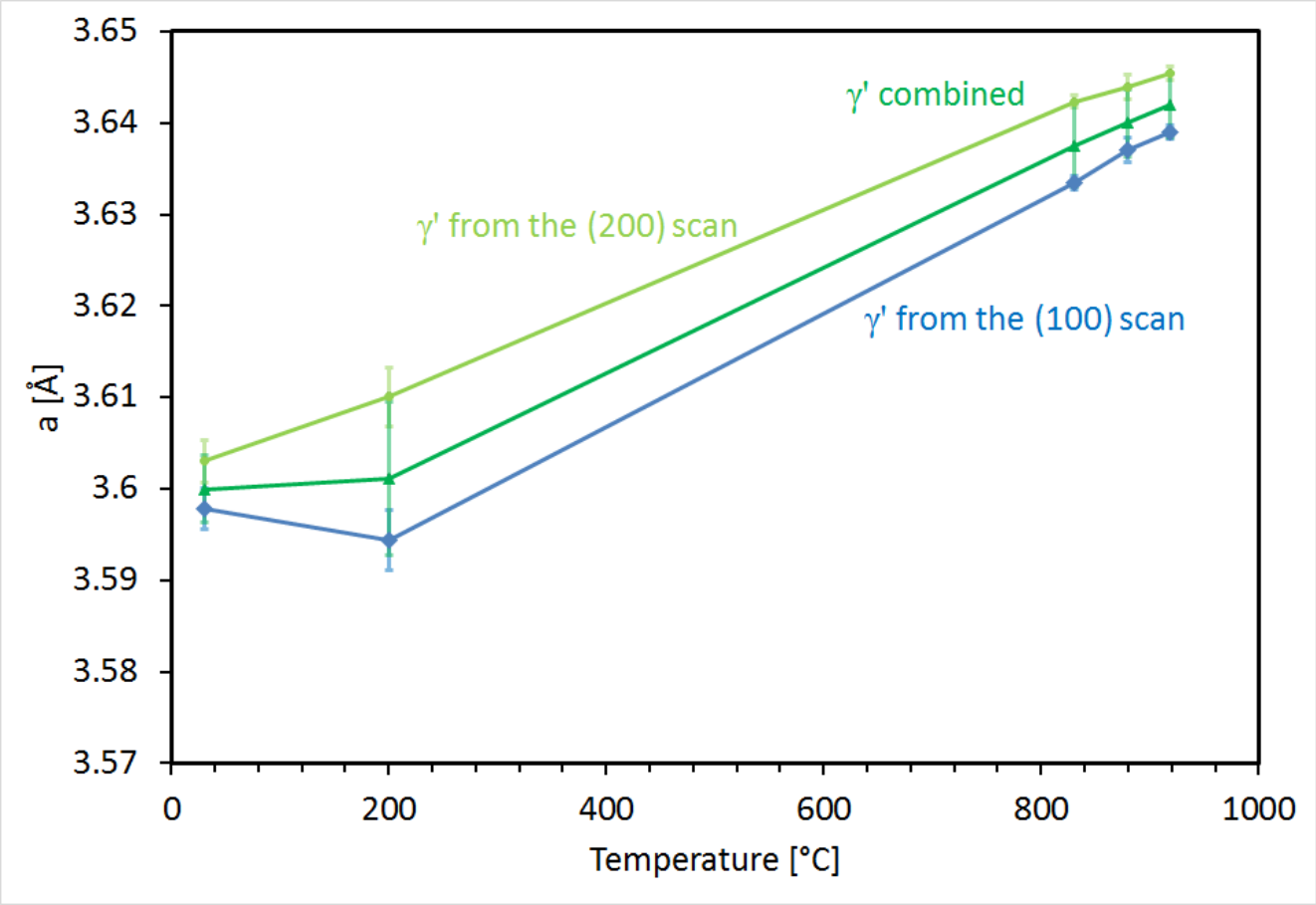

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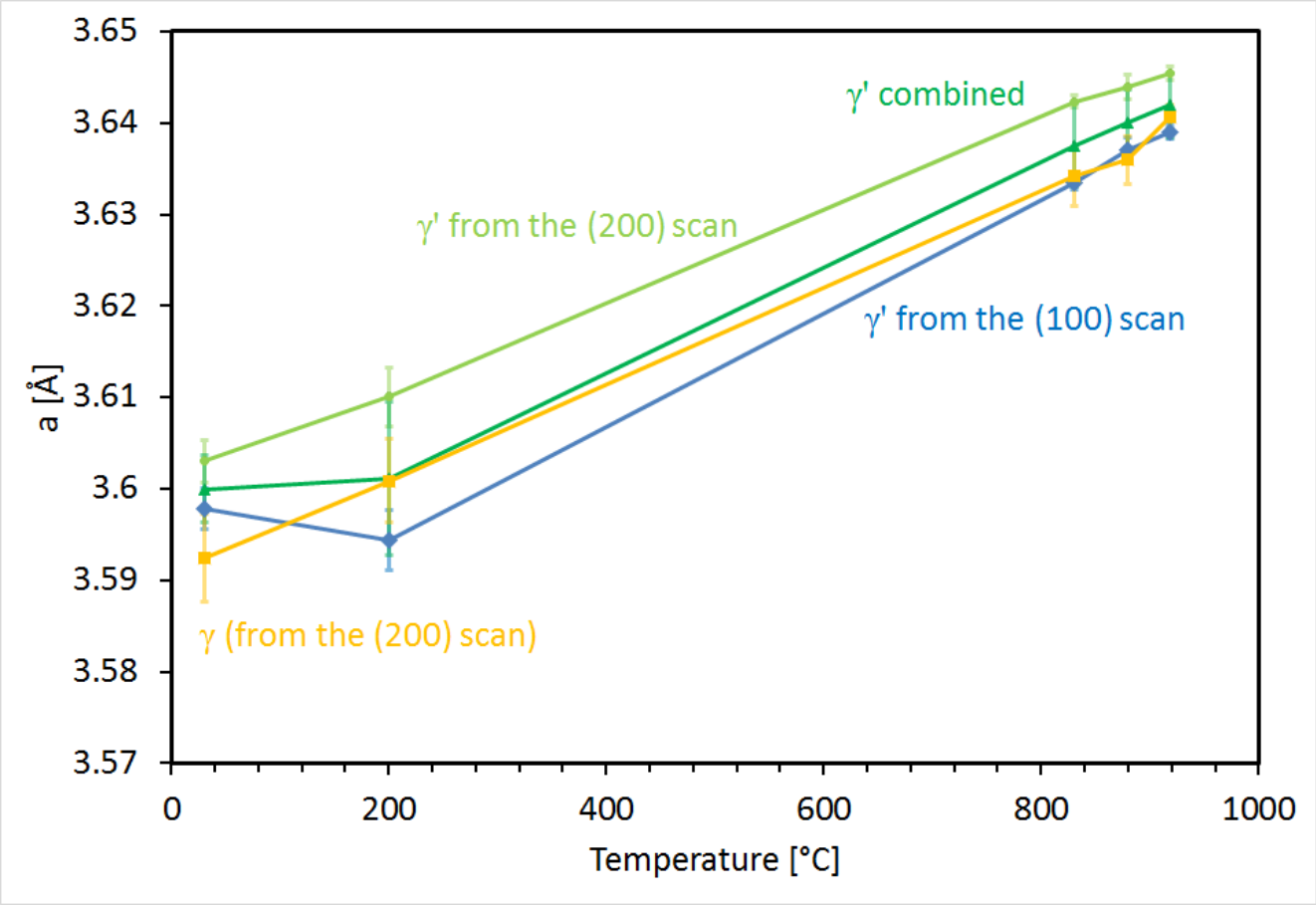

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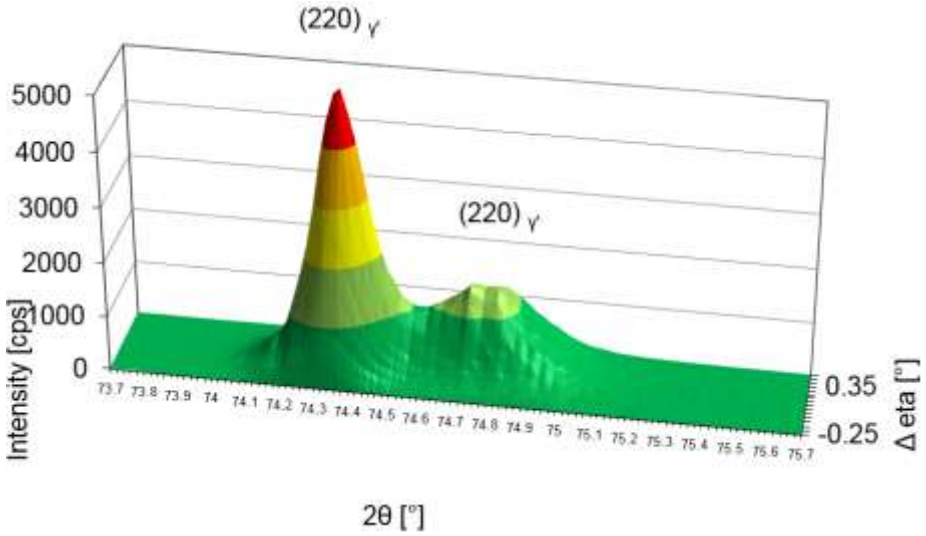
Difficulties - Peak shapes before and after experiment

before



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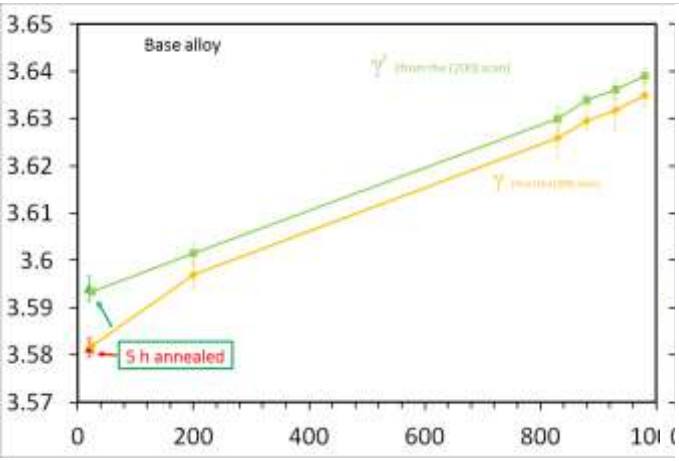
Evolution of the lattice parameters



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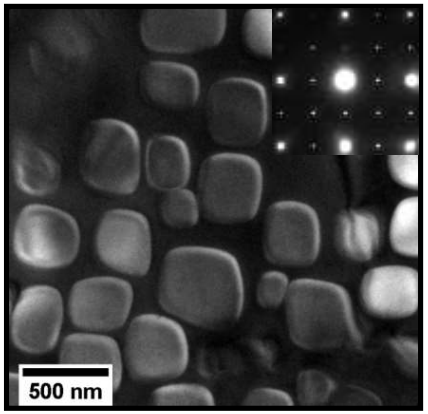

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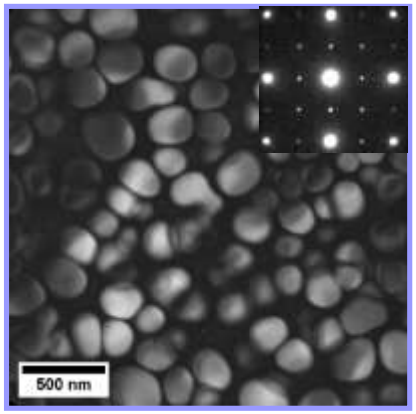
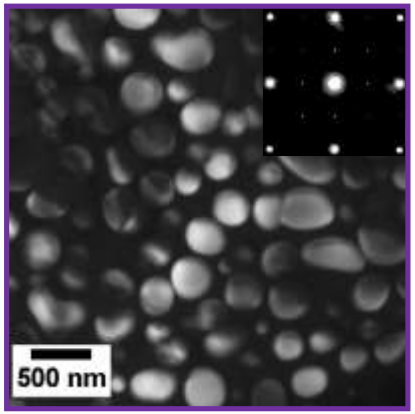
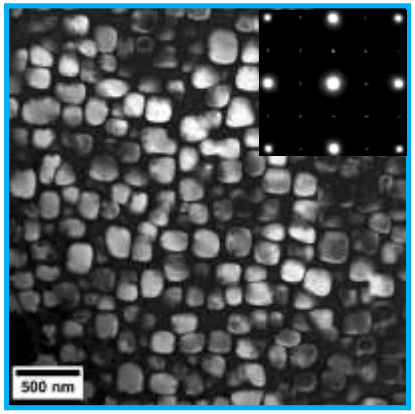


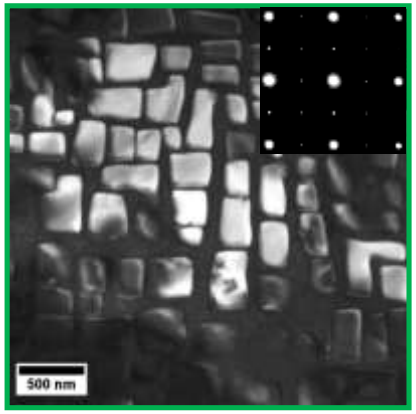
With 1 at.% **Mo**
Ann 900°C 5 h



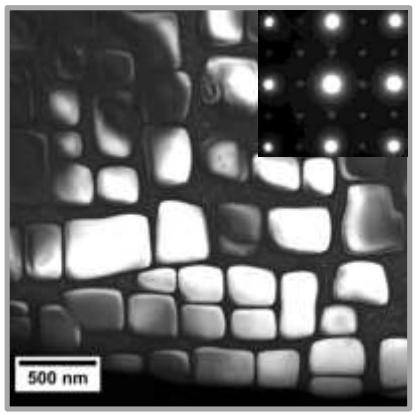
With 1 at.% **Mo**
Ann 900°C 100 h



With 1 at.% **Zr**
Ann 900°C 5 h



With 0.5 at.% **Hf**
Ann 900°C 50 h



With 0.5 at.% **B**
Ann 900°C 100 h

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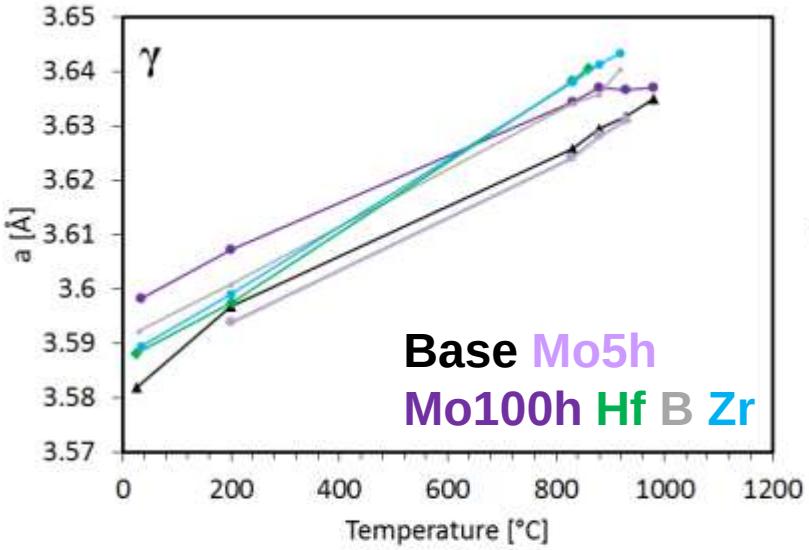
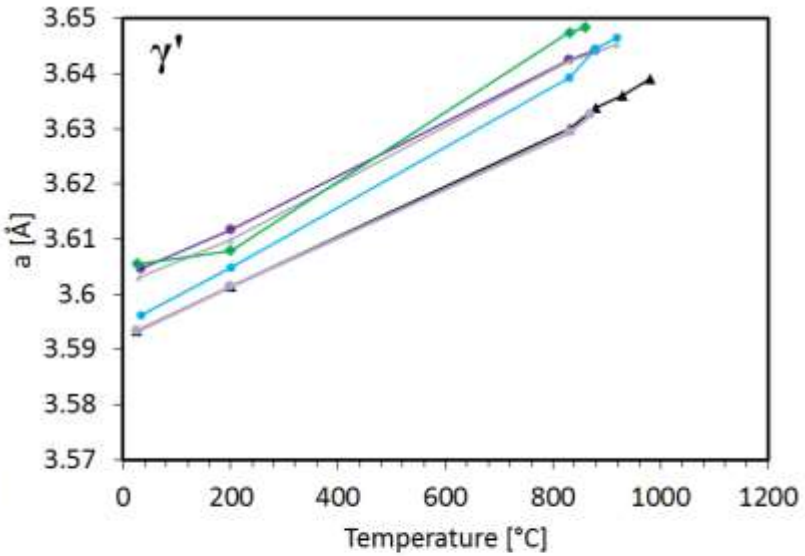
Evolution of the lattice parameters





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Summary

-Measuring the lattice misfit requires high precision tools… and a lot of time to exploit the results!

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Thank you!

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