$NbSe_2$ surface behaviour at the charge density wave transition: an X-ray diffraction study

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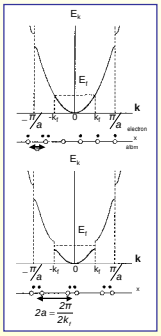
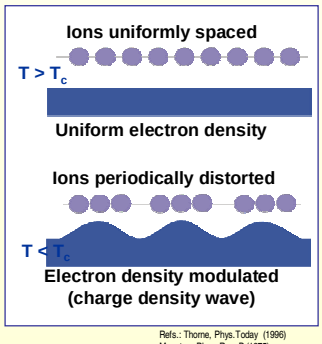
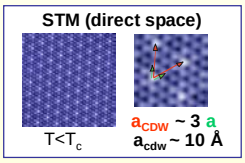
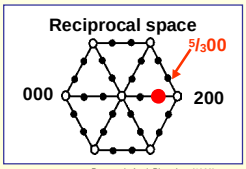
Charge density wave (CDW) transition … in $NbSe_2$





Refs.: Thorne, Phys.Today (1996)
Moncton, Phys. Rev. B (1975)

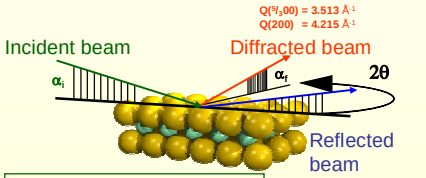




Pan *et al.*, Appl. Phys. Lett (1988)

$NbSe_2$ T_c = 33.5 K

Grazing incidence diffraction (GID) on $NbSe_2$

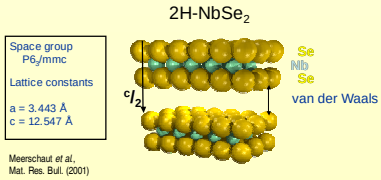


NbSe2 @ 10.5 keV α_c = 0.24 °
α_i = 0.17 ° penetration depth 24 Å
α_i = 0.4 ° penetration depth 2,000 Å

Ref: Dosch, Phys.Rev. B (1987)

$NbSe_2$ sample

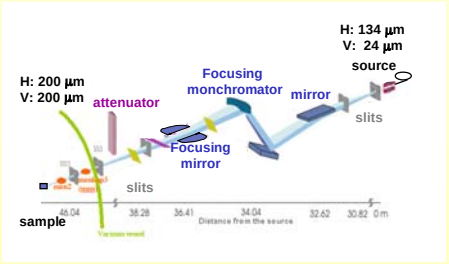
Layered structure, 2D like behaviour

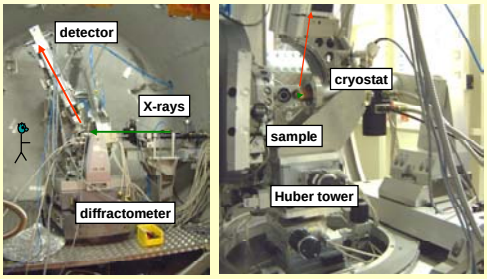


Meerschaut *et al.*, Mat. Res. Bull. (2001)

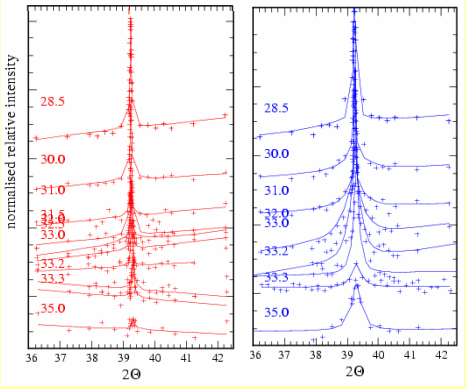
Sample cleaved in air and then cooled in vacuum

Experimental set-up on ID01



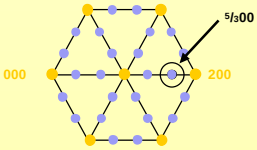


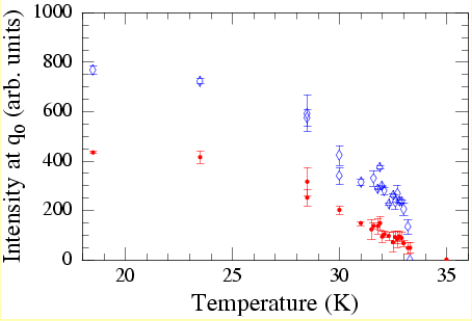
Data analysis and results



Bragg scans through the $^5/_3 00$ satellite reflection (close to T_c)

Measurements of the $^5/_3 00$ satellite reflection

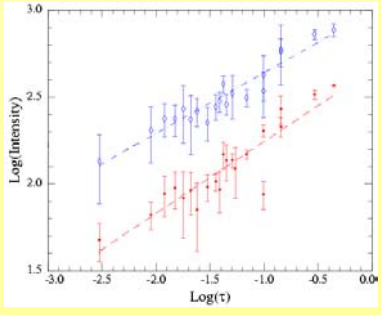




$^5/_3 00$ CDW satellite reflection intensity

bulk $T_{c,b}$ = 33.3 ± 0.1 K
surface $T_{c,s}$ = 34.9 ± 0.3 K

$T_{c,s} > T_{c,b}$: **surface transition?**



Double logarithmic plot of CDW satellite intensity vs. reduced temperature: $\tau = (T-T_c)/T_c$

measured critical exponents

β_b = 0.18 ± 0.02

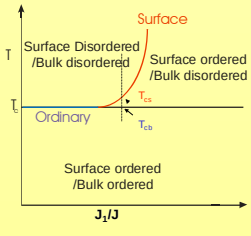
β_1 = 0.20 ± 0.04

calculated

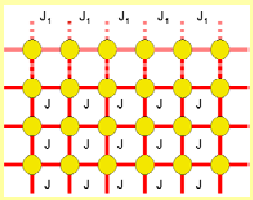
2D Ising: 0.125

3D Ising: 0.325

Classification of surface phase transitions



Binder, Phase Transitions and Critical Phenomena 8 (1983)
Diehl, Phase Transitions and Critical Phenomena 10 (1986)



Coupling constants for a ½∞ system: modification at surface?

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Ref: B. M. Murphy *et al.*, Physica B **336**, 103 (2003)