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Homoepitaxial growth of magnetite (Fe_3O_4) (001)

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The performance of magnetite-based devices and catalysts crucially depends on their surface structure and stoichiometry [1]. While annealing in ultra high vacuum and the adsorption of small molecules (partially) lift the subsurface cation vacancy reconstruction on Fe_3O_4 (001) surfaces [3,4,5], annealing under oxidising conditions results in the growth of new Fe_3O_4 layers involving near-surface cation transport [6].
To study the influence of O_2 pressure on cation transport in the Fe_3O_4 near-surface region, the homoepitaxial growth of Fe_3O_4 by molecular beam epitaxy was observed in-situ by surface X-ray diffraction (SXRD) at different pressures and growth rates.
Details about the grown structures and the growth process obtained from crystal truncation rods and X-ray intensity growth oscillations will be complemented by low energy electron diffraction and X-ray reflectivity data. These results will be presented in relation with their implications for cation transport in Fe_3O_4 [7].

References:
[1] Parkinson, G., Surf. Sc. Rep. 71, 272 (2016); [2] Bliem, R. et al., Science 346, 1215 (2014); [3] Arndt, B. et al., Chem. Comm. 1, 92 (2019); [4] Arndt, B. et al., Surf. Sci. 653, 76 (2016) [5] Arndt, B. et al., PCCP 22, 8336 (2020); [6] Nie, S. et al., J. Am. Chem. Soc. 135, 10091 (2013), [7] Dieckmann, R. et al., Ber. Bunsenges. Phys. Chem. 81, 344 (1977)

Caption:
Fig. 1: Growth oscillations observed by SXRD at (4 0 1.97) (blue), (4 0 1) (green) and (2 2 0.97) (yellow) indicating a layer by layer growth of half unit cells. Growth at 4×10^{-6} mbar O_2 and a flux of 30 nA.

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