ROBL-CRG	**Experiment title:** **Investigation of the amorphisationand recrystallisation of sputter induced nanoscale surface ripples onSi(100) by surface sensitive X-ray**	**Experiment Number:** **20_02_643**
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Names and affiliations of applicants (* indicates experimentalists):

Adrian Keller*, Antje Hanisch*, Carsten Baehtz*,
Stefan Facsko and Jörg Grenzer*

Forschungszentrum Dresden-Rossendorf, Institute of Ion Beam Physics and Materials Research,
D-01314 Dresden, Germany

Report

Nanopatterned templates are a popular tool for creating novel nanostructures and controlling the properties of thin films. Recently, nanoscale ripple patterns which form self-organized during low energy ion sputtering have been used as templates for the deposition of metallic thin films. It was shown, that these patterns can induce magnetic and optical anisotropies in the deposited films. A crucial parameter for the further application of these substrates, e.g. in CVD or MBE growth, is the thermal stability of the patterns. Therefore, the annealing behavior of ion induced ripple patterns on thermally grown SiO_2 films has been studied *in-situ* by GISAXS.
The samples were fabricated by sputtering of SiO_2 with Ar^+ ions with energies between 300 and 1000 eV. Different samples with periodicities ranging from ~ 40 to ~ 70 nm and a ripple height of ~ 2 nm have been annealed in high vacuum for several hours at temperatures up to 1100°C. During annealing, consecutive GISAXS profiles have been obtained in-situ using a CCD detector.

Fig. 1 shows two CCD images obtained before and after annealing at 1000°C for 15.5 h. It is clearly visible that the intensity of the side peaks which is proportional to the ripple amplitude has decreased after annealing. Fig.2a depicts the corresponding AFM images. Surprisingly, after annealing, only a slight decay of the ripples is observed. However, an optical microscope image (Fig.2b) reveals the formation of holes in the SiO_2 film. Such a decay of SiO_2 is known to take place for annealing in vacuum at temperatures of above 1100°C. Therefore, the observed GISAXS

intensity decrease is caused by the instability of the SiO_2 and not by the decay of the ripples itself. On the other hand these measurements demonstrate a quit high temperature stability of the ion induced nano-patterns with a half-life time of more than 20h above 1000°C.

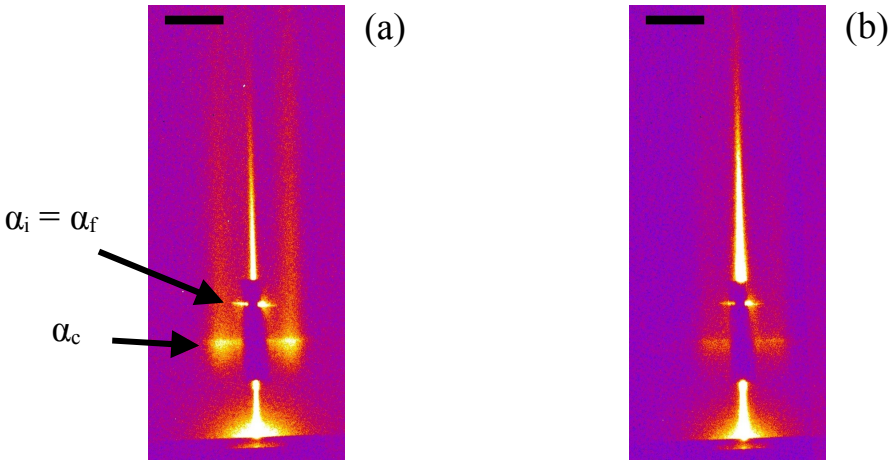

Fig. 1 *GISAXS profiles measured close to the critical angle α_c = 0.17° of a rippled SiO_2 layer with 57 nm periodicity before (a) and after (b) annealing at 1000°C for 15.5 h. The black scale bars correspond to an angular distance of 0.2°.*

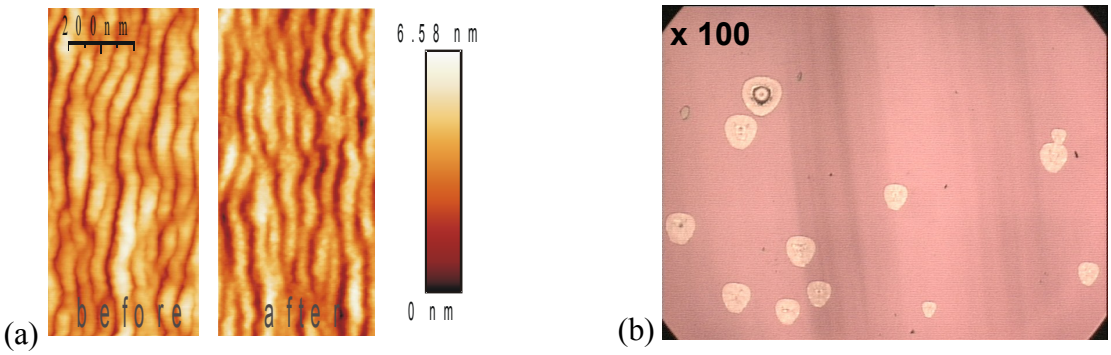

Fig. 2 *(a) Corresponding AFM images of the sample of Fig. 1 before and after annealing. (b) Optical microscope image of the same sample after annealing.*