ESRF	**Experiment title:** Evaluation of early stages or relaxation in SiGe/Si - linear structures as sources and sinks for misfit dislocations	Experiment number: HS-695
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The experiment was a continuation of HS-397, however with a new typ of samples. Because of technical problems during the beamtime, another 2 days beamtime were given in January. The latter beamtime was also used to test a new bent collimator setup, which was provided by our laboratory.

1. Annealing experiments in the temperature range 500-600°C

SiGe/Si samples were available with a variety of growth parameters: range of Germanium content 22-28 %, SiGe layer thickness 70 to 120 nm, growth temperature 500 to 650°C. The samples were either grown by molecular beam epitaxy (MBE) or chemical vapor deposition (CVD). One purpose was the measurement of misfit dislocation propagation velocity. The main purpose however was the investigation of the nucleation behavior at linear laser or implantation structures.

As our experiments have demonstrated, laser written lines provide a comparatively homogeneous linear distribution of nucleation sites. Therefore at annealing temperatures in above range a comparatively straight propagation front of misfit dislocations starts at these lines (see left part of fig. 1). Only MBE samples were used for the experiments with laser or implantation lines. This proved a problem in that these samples had a rather high density of local (unwanted) nucleation sites over the whole area. The misfit dislocation segments starting at such nucleation sites are quite often the source of blocking for crossing propagating misfit dislocations. This becomes expecially obvious at the misfit dislocation front starting at laser lines (see marked blocking events in the right half of fig. 1). As parallel annealing experiments with CVD samples showed, far lower densities of local nucleation sites are possible - here the nucleation sites are mainly local stresses at the sample edges (due to cleaving). This is a precondition for a defined relaxation by artificial nucleations sites as e.g. laser written lines.

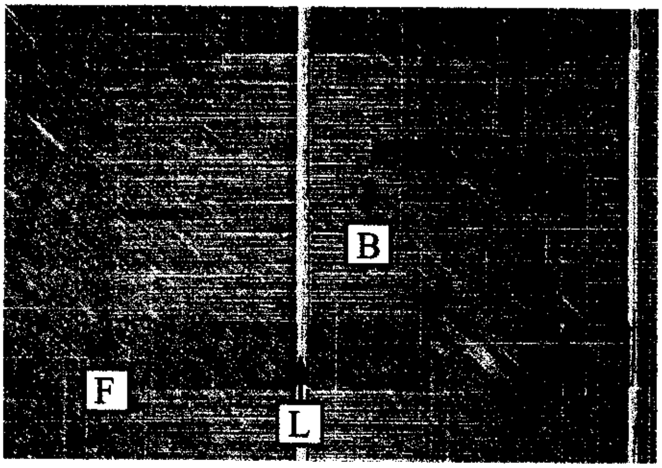

Fig. 1: *Laser written line L acting as source of misfit dislocations (after 10 min annealing at 550°C). (L) laser line , (F) misfit dislocation propagation front, (B) blocking.*

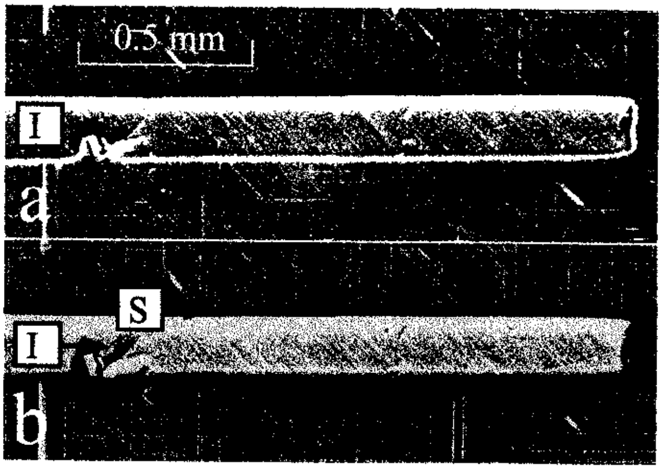

Fig. 2: *Misfit dislocations close to implantation lines (I). (a) before and (b) after annealing (14 min at 500° C)*

It could be demonstrated, that implantation lines are effective sinks for misfit dislocation propagation. Fig. 2 a was taken prior to annealing and shows some misfit dislocations lines which were present before implantation. Misfit dislocation which propagate during annealing are blocked (S) at a distance of about 20 µm from the implantation line (fig. 2b).

Investigation of the described nucleation and blocking processes by means of atomic force and transmission electron microscopy is still in progress.

2. Contrast study

In principle radiation at energies around 8 keV is advantageous for above investigations. However, with the intensities available nuclear plates are still a favourable 'detector system'. These are practically impenetrable at those energies. Therefore the double crystal setup was chosen in such a way (collimator with nearly symmetric (224)-reflection; sample (044)-reflection at 3° glancing incidence angle) that higher order radiation (from (448)- and (088) reflection at about 16 keV) was still present at some angular offset. This radiation passes the nuclear plates. Its signal at a x-ray sensitive electronic 2D-detector is used in order to keep imaging conditions constant during annealing (drift compensation). The image contrast due to this combined radiation was studied in dependence on the exact angle on the rocking curve. Obviously the optimum contrast is not (as usually) in the steep flanks or the tails of the rocking curve, but rather close to its 'top'. It is still unclear whether the effect is mainly due to superimposition of these two energies or to sample curvature. Contrast simulations are planned, which will take into account the effect of the curvature of collimator crystal and sample.