ESRF	**Experiment title:** Tungsten line gratings deposed onto silicon membrane characterized by CD-SAXS	**Experiment number**: 02.01.855
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Report:

In order to control the dimensions of tungsten lines, SAXS experiments were performed using photon energy of 17 keV, to cross a 700 µm silicon wafer, and a beam focused at the sample position with horizontal and vertical widths equal to 300µm and 150µm. The SAXS patterns were recorded using a XPAD pixel detector (960*560 pixels, 130 µm pixel size) mounted on the SAXS bench and located at a distance of 3134 mm from samples.

In order to quantify precisely the precision of the CD-SAXS technic, two kinds of "reference" samples were studied. It consists of Tungsten line gratings deposed onto silicon membranes:

- ✓ "1D" lines (periodicity only along the transversal direction of lines, Fig. 1a), allowed us to determine (Fig. 1c), from the position and the relative intensity of the diffraction spots, the periodicity of the array, i.e. from the structure factor (~100 nm), and the lines width, i.e. from the form factor (~35 nm). The values are in agreement with the one obtained by CD-SEM analysis. Moreover, the trapezoidal form of the lines were also determined thanks to CD-SAXS patterns obtained after rotation of array of line along the y axis, leading to form factor of lines in the qz direction of the reciprocal space, Fig. 1e.

- ✓ "2D" lines, with a controlled roughness along lines, Fig. 1b, were also studied. As shown in Fig. 1d, the periodicity along the y direction leads to the apparition of several lines of diffraction spots. Thanks to the method used for the D lines, a period of ~200 nm and a line width of ~90 nm were extracted. Moreover, the intensity ratio and the distance between two lines of spots allowed us to extract le roughness periodicity (~100 nm) as well as the amplitude (~10 nm).

Finally, we also performed CD-SAXS measurements on line grating generated with e-beam lithography spin coated on 700 µm Si wafers, samples more conventional in the domain of nanolithography. The period and line width were in good agreement with CD-SEM analysis. Therefore, a line roughness with very low amplitude (~ 2-3 nm), not detectable with conventional technic used in metrology, was measured.

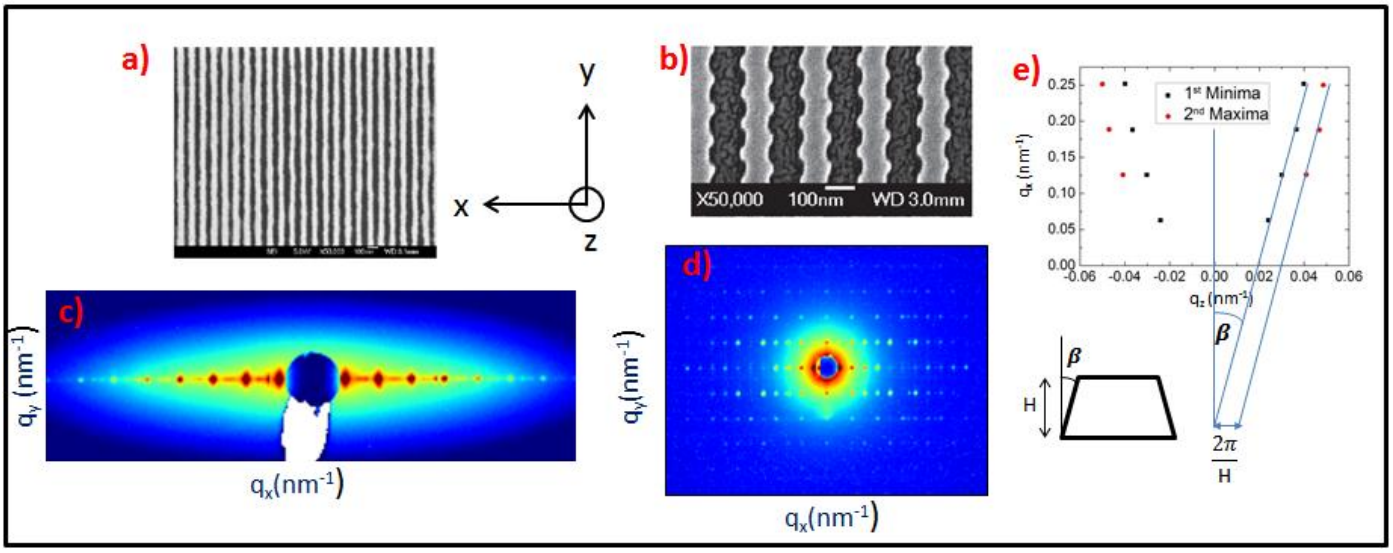

Figure 1 : Clichés de contrôle dimensionnel par SEM (CD-SEM) sur des lignes: a) 1D et b) 2D. c) et d) sont les clichés CD-SAXS sur ces mêmes lignes. e) détermination du facteur de forme de lignes trapézoïdales.

In order to treat and to simulate all the datas obtained during this experiment, a software is under devlopement. In parallel, we are also performing CD-SAXS measurments with laboratory equipements. These results will be presented at the “RX et Matière 2015” conference in Grenoble.