Grating interferometry at ESRF: recent improvements and developements

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Introduction and Objectives

X-ray grating interferometry is a multimodal x-ray imaging technique that was developed in the early 2000's [1]. During the last decade the technique has been extensively exploited for soft material characterization and biomedical applications [2,3]. Several characteristics make this technique of great interest for a wide range of applications. It simultaneously acquires three different image signals: absorption, differential phase and dark-field [4]. It enables the 3 dimensional quantification of the index of refraction of materials. Furtheremore, this technique can be easily implemented at laboratory x-ray sources [5]. For all these reasons grating interferometry is of particular interest for many different fields in need of high sensitivity in the micrometer range. However, the image acquisition procedure remains quite long (~ few hours) in comparison to other x-ray imaging techniques such as propagation-based imaging (~ few minutes). This work presents an important step on the way of making the image acquisition in grating interferometry shorter and competitive with other phase contrast imaging techniques.

Results and Discussion

In the following we will show the latest advances of the instrument at the ID19 beamline of the ESRF, which was previously only used with monochromatic x-rays with an energy bandwidth of $\Delta E/E \approx 10^{-4}$ reached by Bragg-reflection/double-crystal monochromator Si(111). The instrument has now been characterized using x-rays with a broader energy bandwidth of $\Delta E/E \approx 10^{-2}$. A specific high sensitivity phase-phantom was designed for this purpose. We show the results of the measurement of this phantom and we discuss the challenges of making the imaging procedure shorter while keeping the quantitativeness and the high sensitivity of it.

Conclusions

Grating interferometry is a unique technique to quantitatively characterize the index of refraction of different materials with a sensitivity that is not comparable to any other non-destructive technique. The use of broader energy bandwidth x-rays and higher flux can be usefull to perform shorter scans. Big efforts are being made towards faster acquisition schemes that will in the near future shorten the experimental time needed.

References

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