Geometry reconstruction of nanostructures using X-ray scattering and fluorescence measurements

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Ever smaller and more complex three-dimensional nanostructured semiconductor surfaces are essential components of many modern technological products, most prominently advanced integrated electronic circuits. These devices need to work with ever tighter tolerances on their geometry and composition. Advanced metrology allows inspecting the characteristics of fabricated novel nanostructured surfaces and, thus, enables the technological development of the IC's components.

Optical metrology is an all-rounder in semiconductor production because it allows a fast and non-destructive inspection of structured areas in the infrared, visible and X-ray spectral ranges. The German national metrology institute (PTB) is engaged in developing experimental and analytical methods in the UV to X-ray spectral ranges at the storage ring BESSY II.

Soft X-ray scattering is known for being used with high precision to determine the geometrical features of periodic structures and X-ray fluorescence determines the elemental composition of these structures [1, 2]. The hybrid approach takes advantage of the incident radiation which simultaneously stimulates X-ray fluorescence when soft X-rays are scattered on a nanostructured surface. This novel method provides more information about the nanostructured surface from the experiment, reduces measurement uncertainties and copes with more complex structures.

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[2] P. Hönicke, A. Andrle, Y. Kayser, K. V. Nikolaev, J. Probst, F. Scholze, V. Soltwisch, T. Weimann, and B. Beckhoff. Grazing incidence-x-ray fluorescence for a dimensional and compositional characterization of well-ordered 2d and 3d nanostructures. *Nanotechnology*, **31(50)**:505709, Oct. 2020.