Surface analysis by XRF and XPS for the Avogadro constant and the realization of the kilogram based on silicon spheres

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The determination of the Avogadro constant for the redefinition of the SI unit kilogram as well as the eventual realization of the kilogram by monocrystalline enriched $^{28}$Si-spheres require a reliable surface analysis on silicon spheres. A novel instrumentation for the quantitative surface analysis of silicon spheres combines X-ray fluorescence spectroscopy and X-ray photoelectron spectroscopy techniques in order to enable the characterization and quantification of the oxide layer and unintentional contaminations. The analysis relies on the combination of the complementary X-ray methods. Measurements on $^{28}$Si-spheres were carried out. The surface was characterized regarding the elementary composition including the chemical binding states of the components and the mass of the surface layer.