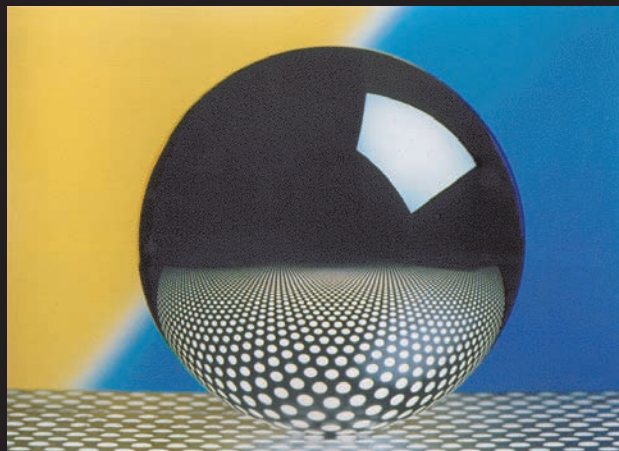


# Peter Becker

## “The Silicon Route to a New Kilogram”

**Peter Becker** received his Ph.D. degree from Dortmund University in 1974 (Professor Dr. U. Bonse). He then joined the Physikalisch-Technische Bundesanstalt (PTB) and was head of the section for x-ray metrology from 1978 until 2004. Since 2004 he has served as head of the department of Quantum Optics and Unit of Length at PTB. His research interests are x-ray interferometry, silicon micromachining, and determination of fundamental physical constants. Since 2003 he has been the coordinator of the international Avogadro project within the CCM (“Comite Consultatif pour la Masse et les grandeurs apparentees” of the meter convention) dealing with the redetermination of the Avogadro constant with the aim to re-define the unit of mass, the kilogram. He is also chairman of the CCM working group “Avogadro

Highly purified silicon single crystals are excellent standards for length measurements at the atomic scale. The value of the silicon (220) lattice spacing is an important item of information for the establishment of a self-consistent set of fundamental physical constants. This talk surveys d220 determinations by describing the measurement process using x-ray/optical methods. The investigations of lattice defects such as impurities and self-point defects by x-ray diffraction methods are demonstrated, with emphasis on their number density and their influence on the lattice parameter. From these investigations one can consider—with a relative standard uncertainty of about  $1 \times 10^{-8}$ —the lattice



parameter of an impurity-free crystallographically perfect or “ideal” silicon crystal under specified conditions (principally growth parameters, temperature, pressure, isotopic composition) to be an invariant quantity of nature. A summary of applications of calibrated silicon crystals in the field of fundamental constants, such as the Avogadro constant, the molar Planck constant, and the fine-structure constant, and related quantities such as wavelengths of x-rays and  $\gamma$ -ray will also be

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