APPLICATIONS OF PIEZOELECTRIC QUARTZ CRYSTAL MICROBALANCES (METHODS AND PHENOMENA, VOL. 7),

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The scope of the series is quite wide. Preceding volumes cover, among others, the methods of surface analysis, the application of ultrasound in medicine and biology, ballistic materials, penetration mechanics, etc. Volume 4, dealing with the problems of microweighing in vacuum and controlled environments with beam balances, was reviewed in this Journal earlier (vol. 20, 1981, p. 549).

Microweighing with quartz crystals is based on the fact that the resonance frequency of a mechanically vibrating crystal is influenced by the mass of oscillator. The frequency change of the crystal is therefore characteristic of the mass (or, more exactly, the areal density) of the solid material deposited on the surface. The mass to frequency relation is linear in the range of small mass loads. For weighing purposes, properly-cut quartz crystals are used, because of their high mechanical stability and wide temperature range of operation (from very low temperatures to about 840 K). The frequently used 9 MHz crystals are 10–16 mm sheets of approximately 0.19 mm thickness, cut in a special crystallographic direction. The mass sensitivity of such crystals is about 0.4 Hz/ng; the detection limit of quartz crystal microbalances (QCM-s) is estimated to be about 10^{-12} g/cm^2, which corresponds to 0.1% of an adsorbed hydrogen monolayer. This extremely high mass sensitivity is the primary factor determining the field of application. On the other hand, the temperature-dependence of the resonance frequency is the most important limiting factor. This is why beam microbalances are usually superior when measurements at widely differing or changing temperatures are required.

The book covers all the important aspects of the theory, design, operation and application of QCM-s. The first chapter, written by the Editors, contains a brief introduction and a summary of the following parts, written by eleven well-known experts in the field. Chapter 2 is devoted to the theory, design and operation of QCM-s, while Chapters 4 and 5 discuss simultaneous mass + stress and mass + temperature measurements, respectively.

A major field of application relates to the studies, analysis and technology of solid surfaces. Separate chapters (3, 6 and 7) describe the use of QCM-s in thin film deposition process control, surface science and plasma assisted etching.

Chapter 8 is devoted to applications in chemical analysis, including detectors for gas and liquid chromatography and a number of air pollutants, such as sulphur dioxide, ammonia, aromatic substances, pesticides, etc. The last two chapters discuss the role of QCM-s in space system contamination studies and aerosol measurements.

The book as a whole has achieved its goal: "to provide a single effective source on the theory, design, artifacts and varied applications of the piezoelectric quartz microbalance". In all the chapters the style is clear and logical, and the figures and tables are informative. Several (but not all) contributions can be read and understood without reference to others, which may be an advantage for readers interested in one special aspect only.

Since the QCM will certainly gain even more applications in the future, the book can be recommended to anyone interested in high-sensitivity mass measurement in controlled environments.

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