

Silicon-Based Chemical Sensors and Chemical Analysis Systems

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Two examples of amperometric and potentiometric chemical sensors that are realized with the use of integrated-circuit (IC)-compatible fabrication techniques are presented. The amperometric sensor is a free-chlorine sensor that is used to monitor the added disinfectant (hypochlorous acid) in drinking water. As potentiometric sensors, different membrane-covered ion-sensitive field-effect transistors (ISFETs), sensitive to calcium and potassium, are described. Since the realization of the basic silicon transducer with these techniques is presently standard, emphasis is laid on the compatible on-wafer deposition and patterning of the membranes needed to provide the chemical sensitivity and selectivity of the basic devices. A new, general method for obtaining photosensitive ion-selective membrane matrices is presented. Finally, it is shown how integration of an ISFET-based chemical sensor array with miniaturized liquid-handling elements such as valves and pumps, realized in silicon, results in a miniaturized analysis system with improved performance compared to conventional analysis systems, with respect to sample time, sample size and use of calibration solution.

1. Introduction

The rapid development of integrated-circuit (IC) technology during the past few decades

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