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Distribution of ΔV_T of Dual FETs in View of Their Application to Differential Measurements with ISFET-MAOSFET Pairs

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A dual FET (ISFET-MAOSFET) using Al_2O_3 on SiO_2 as the gate insulator has been fabricated. The influences of the interfaces between SiO_2 and Al_2O_3, and between Al_2O_3 and the electrolyte solution on the uniformity of the V_T (threshold voltage) for individual FETs and ΔV_T (the difference of the V_T between two FETs of the pair) over a wafer have been studied. The distributions of ΔV_T have shown comparable standard deviations for MOSFET (metal silicon dioxide semiconductor field effect transistor) pairs (31 mV), for the MAOSFET (metal alumina silicon dioxide semiconductor field effect transistor) pairs (29 mV) and for the ISFET-MAOSFET pairs (29 mV). These results have led to the conclusion that the packaging and the Al_2O_3/SiO_2 and liquid/solid interfaces do not change the uniformity of the threshold voltages.

1. Introduction

Since the first pH-ISFET was presented,[1] many investigations on the pH sensitivity, long-term drift and temperature response of the ISFETs have been carried out. A pH sensitivity of 55 mV/pH and a long-term drift of 0.2 mV/hr were measured for the ISFET with Al_2O_3 as a sensitive layer.[2] The temperature response and the long-term drift of the ISFET affect the accuracy of the sensor. Since these effects are mainly due to solid-state effects, as shown before,[3–5] they can be compensated by a differential measurement setup using a MAOSFET and an ISFET, as is