Room temperature processed ISFETs based on amorphous semiconductors oxides

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Since Ion Sensitive Field Effect Transistors (ISFETs) were introduced by Bergveld in 1970, much effort is put into new and improved materials for device optimization and sensitivity enhancement [1]. ISFET based biosensors have a fast response, are suitable for miniaturization and arrays can be made for simultaneous measurement of various parameters. Actually, ISFET device production relies on standard CMOS technology where miniaturization and chip integration is easily achieved but high processing temperatures are required.

Amorphous semiconductor oxides, such GIZO (compound mixture of Ga2O3:In2O3:ZnO), are considered as a promising material as an alternative to silicon due to its high mobility, and TFTs based on this ternary system have already proven to have high electronic performances [2]. An advantageous technique for these oxide films deposition is radiofrequency (rf) magnetron sputtering because it permits the production at low temperatures of good quality films with smooth surfaces and the use of low cost disposable substrates such as plastic and even paper.

We present the results obtained with ISFET based on amorphous semiconductor. The transducer device consists on a TFT with GIZO as the semiconductor and Ta2O5:SiO2 as the dielectric and the sensitive layer comprises an amorphous Ta2O5 film deposited on an extended gate. The oxide thin films were all produced by rf- magnetron sputtering and the processing temperatures did not exceed 150°C. A full characterization of the device in the linear and saturation regime was performed with pH buffer solutions, and the stability was evaluated. The results show a sensitivity of 40 mV/pH in both linear and saturation regimes with a small hysteresis of near 50 mV and good linearity between pH4 and pH10 solutions. These results clearly show that this new kind of devices can be a good choice when considering cheap and disposable sensors.


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