

A pH Sensitivity Control Method Using Hydrogen Annealing for Reference Field-Effect Transistors

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Many studies have been carried out on the use of ion-sensitive field-effect transistor (ISFET) and reference FET (REFET) devices for pH measurements. In previous works, different materials were used for the sensing membranes of ISFET and REFET devices so that the pH sensitivity of the REFET was much less than that of the ISFET. In these cases, it proved difficult to cancel out the variation in the AC voltage component in the solution by synchronizing the output signals of the REFET and ISFET. Therefore, we put forward a new proposal, in which we use hydrogen annealing to decrease the pH sensitivity of a Si₃N₄ film. Devices comprising Si₃N₄ on SiO₂ on n-type Si substrates were fabricated. The pH sensitivity of a device annealed in hydrogen for 20 min at 400 °C was reduced from 54.6 to 32.6 mV/pH. A higher temperature annealing was largely ineffective in producing greater decreases in sensitivity, and the annealing affected only the surface of the Si₃N₄ film, not its interior. We succeeded in developing the fabrication technology for a device with low pH sensitivity to be used as a REFET.

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