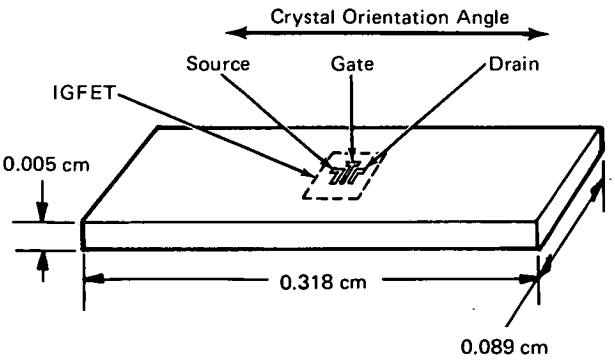
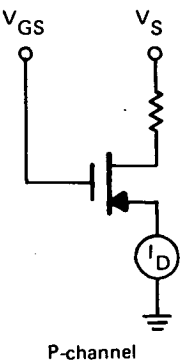
NASA TECH BRIEF

Langley Research Center

Insulated-Gate Field-Effect Transistor Strain Sensor

An insulated-gate field-effect transistor (IGFET) strain sensor that can be switched on and off has been developed. As is shown in the figure, the strain sensor consists of a p-channel enhancement IGFET on a thin filament of n-type silicon oriented parallel to the <111> crystallographic axis. A silicon dioxide layer approximately 3000 angstroms thick is sputtered over the IGFET for passivation. For maximum strain sensitivity, the flow of the drain current, I_D, is parallel to the <111> axis.





P-channel

For most applications, the sensor is epoxy bonded to the surface where the strain is to be measured. The strain is determined by measuring the change in I_D for a constant source voltage, V_S, and gate to source voltage, V_{GS}. The IGFET strain sensor has a gage factor, G_f, ($G_f = \frac{\Delta I_D}{I_D \epsilon}$, where ϵ is the strain) of approximately 150 with a temperature dependence of approximately 0.3 percent/°C. The temperature dependence of I_D can be positive, zero, or negative depending on the gate to source voltage. The IGFET strain sensor can be turned on or off by the application or removal, respectively, of the gate to source voltage.

Notes:

1. This sensor is most useful for applications where it is desirable to integrate the strain sensor with microelectronic circuits for multiplexing.
2. The n-channel IGFET strain sensors can be made in an analogous manner with the exception that the crystal orientation should be <100>.
3. Requests for further information may be directed to:

   Technology Utilization Officer
   Langley Research Center
   Mail Stop 139A
   Hampton, Virginia 23365
   Reference: B72-10731

Patent status:

NASA has decided not to apply for a patent.

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Category 01