Velocity modulation nano-FETs based on a inter-subband transition

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InGaAs quantum-wire field-effect transistors (QWR-FETs) have been fabricated on (311)A InP V-groove substrates by hydrogen-assisted molecular beam epitaxy. Enhanced negative differential resistance (NDR) effects with a peak to valley ratio (PVR) as high as 13.3 have been observed at an onset voltage of 0.17 V in the QWR-FETs at 24 K. The NDR-FET is a velocity modulation transistor based on a subband transfer of electrons from the high mobility fundamental level to the low mobility higher subband levels. The NDR effects were observed up to 260 K as the In content was increased to 0.8. A unique feature of the QWR-FET is that NDR effects are controllable with the gate bias in a three-terminal configuration, and they are favorable for high speed and high frequency modules with reduced circuit complexity.

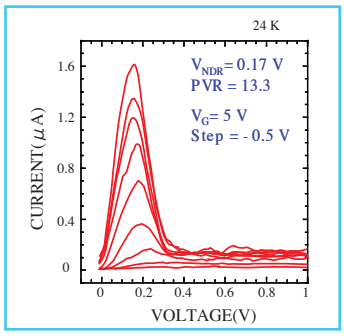

Fig 1: NDR characteristics of a 100nm-gate QWR-FET.

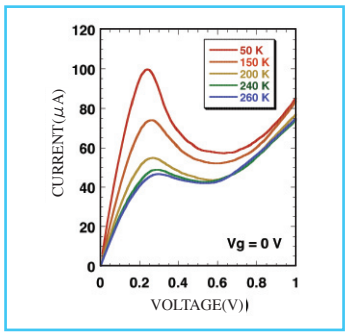

Fig 2: Temperature dependence of the NDR characteristics of a In0.8Ga0.2As QWR-FET.

Self-Aligned-Gate Ferroelectric FET with Long Memory Retention

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A ferroelectric-gate field-effect transistor (FeFET) of a self-aligned-gate type has been fabricated. It has been demonstrated that an ON/OFF drain current ratio larger than 10^5 was held for 16 days after data writing. The success in this self-aligned-gate type means possible downsizing of FeFETs, which is indispensable for large-scale integration of non-volatile memory to the next generation. The development of one-transistor type FeRAMs and non-volatile logic integrated circuits will be accelerated.

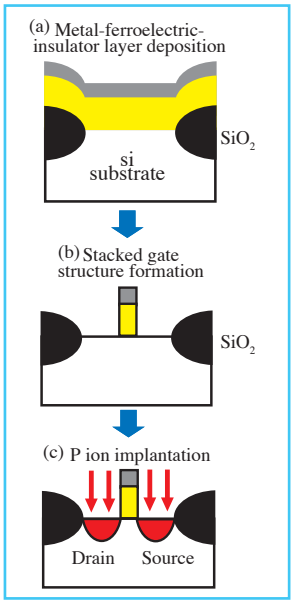

Fig 1: Fabrication process of ferroelectric gate FET by self-aligned gate technique.

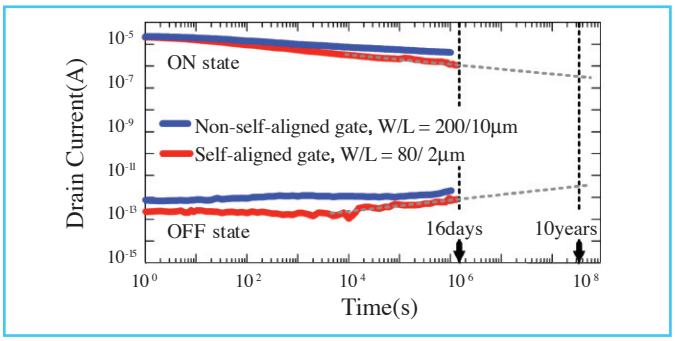

Fig 2: On- and off- drain current retention characteristics of ferroelectric gate FET fabricated by self-aligned gate technique (red curves). The curves for non-self-aligned gate ferroelectric FET (blue curves) were also added as references.