

Oxide/Group-IV Semiconductors



Enhanced Tunneling Drastically Extending Battery Life of IoT Devices

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1. Tunneling Field-Effect Transistors (TFETs)

In FETs, drain current of subthreshold swing (*S* factor) is limited by Boltzmann tail of carriers.

S factor of TFETs is small because overlap of DOS between source and channel is directly modulated by gate voltage. However, *ON* current of homo-junction TFETs and *ON/OFF* current ratio of III-V heterojunction TFETs were low.

3. Experiment

pulsed laser deposition of a non-doped ZnO layer

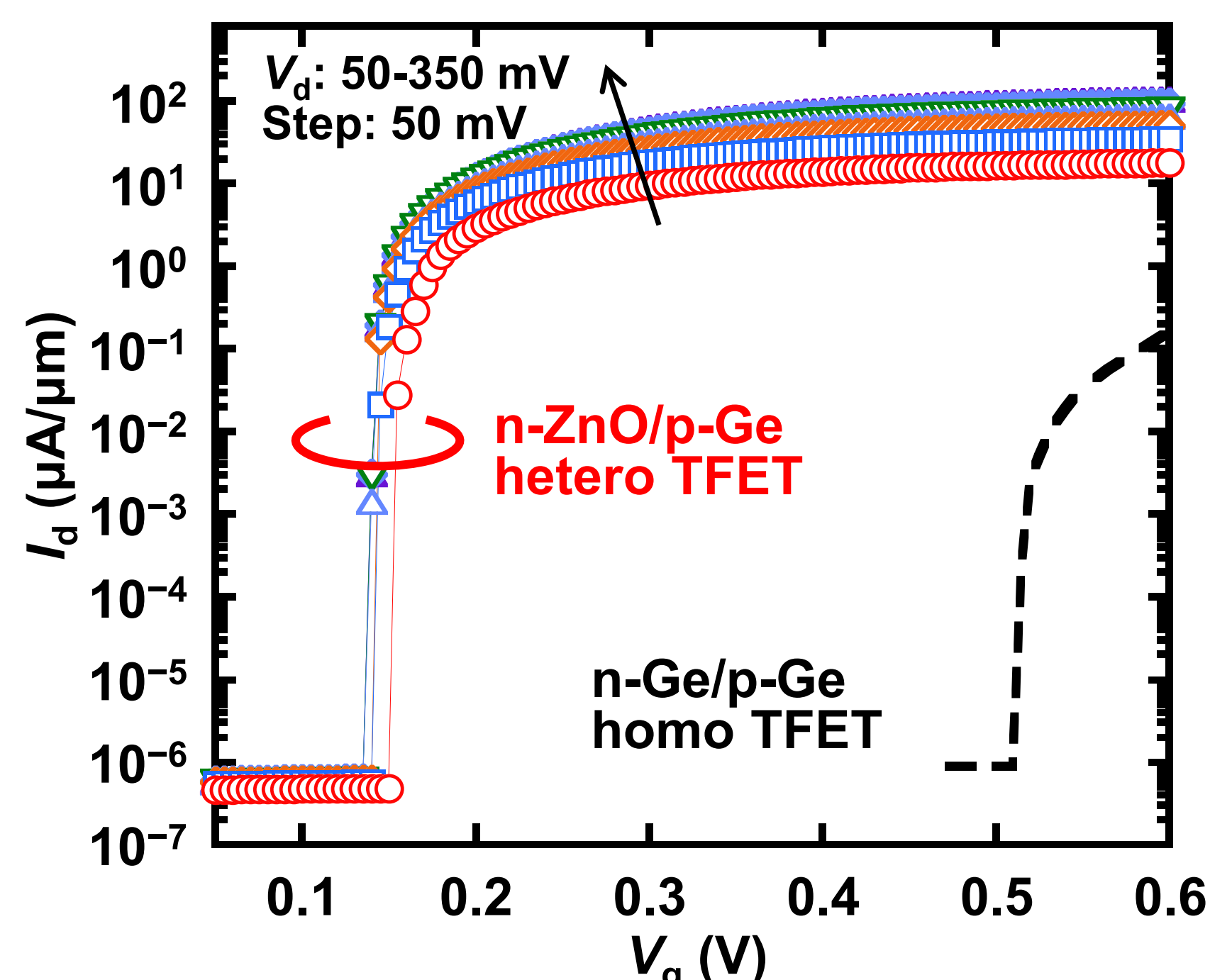
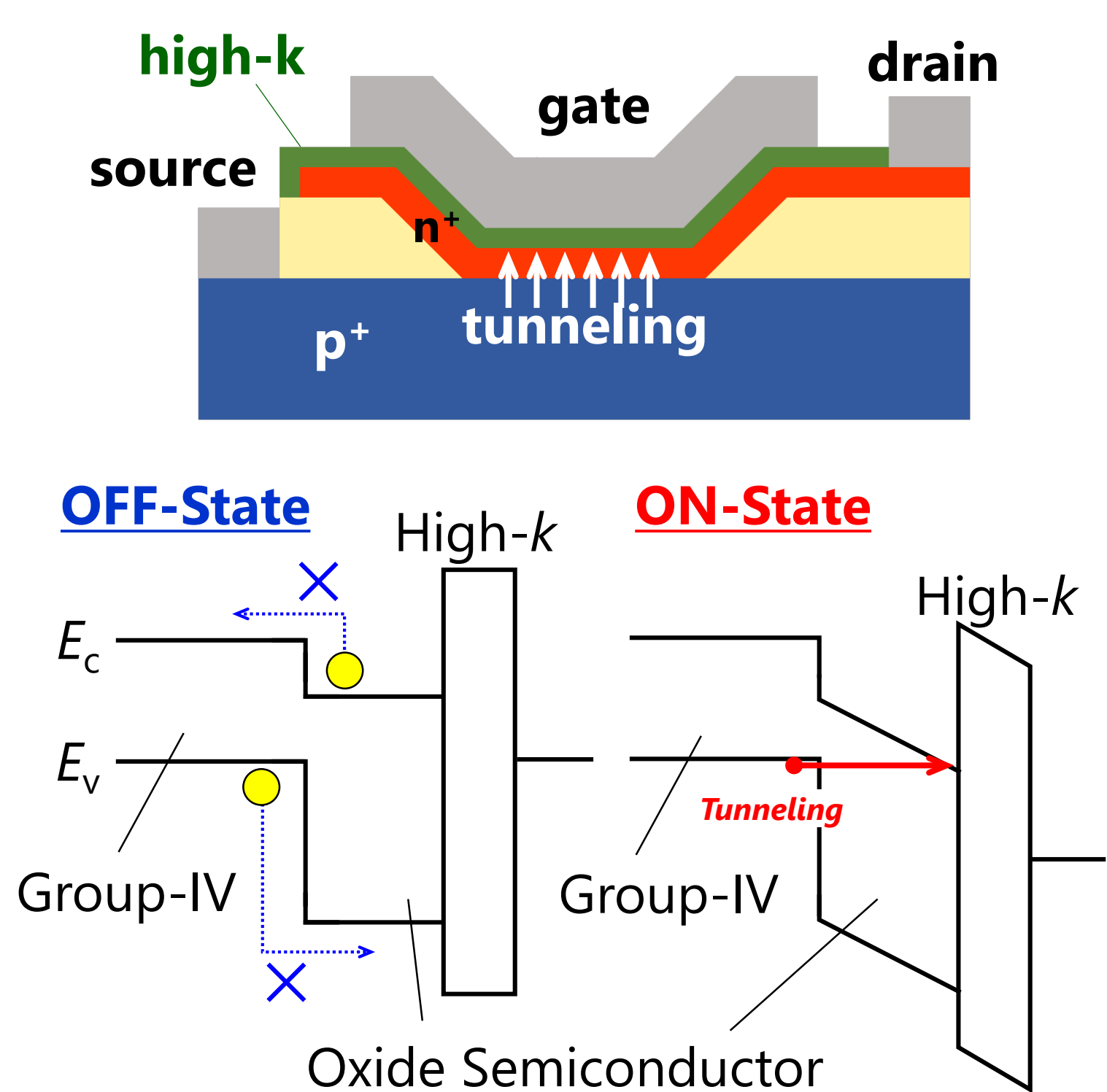
O plasma, O₂ anneal, Al₂O₃

ZnO/Si TFET, ZnO TFT

Record-high *ON/OFF* current ratio of $\sim 10^8$ among TFETs reported so far

2. Our Technology

Oxide-/group-IV-semiconductor (OS/IV) bilayer TFETs for small *S* factor, large *ON* current, and large *ON/OFF* current ratio



Simulated drain current/gate voltage characteristics of n-OS/p-Ge TFET with various drain voltage.

4. Application Example: Unitary construction of n-/p-TFETs

power-supply voltage, back gate, n-type OS, p-type IV, drain, input, gate, output, n-type OS, p-type IV, back gate

OFF state, ON state

Excellent power saving

Energy-efficient IoT (Internet of things) devices

5. Patent Licensing Available

Patent No.: WO2019/107411
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