Symmetric Lateral Bipolar Transistors as Low Noise Signal Amplifier

Qitao Hu
Department of Engineering Sciences
Uppsala University
Uppsala, Sweden
qitao.hu@angstrom.uu.se

Shi-Li Zhang
Department of Engineering Sciences
Uppsala University
Uppsala, Sweden
shili.zhang@angstrom.uu.se

Si Chen
Department of Engineering Sciences
Uppsala University
Uppsala, Sweden
si.chen@angstrom.uu.se

Zhen Zhang
Department of Engineering Sciences
Uppsala University
Uppsala, Sweden
zhen.zhang@angstrom.uu.se

Bipolar junction transistors (BJTs) are characterized by superior high frequency and low noise performance in comparison with metal-oxide-semiconductor field-effect transistors (MOSFETs). A lateral version of the BJT (LBJT) fabricated on silicon-on-insulator (SOI) substrates with a fully CMOS-compatible and low cost process has large potential to improve the power performance of traditional bipolar circuits [1]. Meanwhile, BJTs with high current gain (β) can serve as a local signal amplifier and are of considerable interest in sensor applications. It has been demonstrated that an intimate integration of BJTs with FET-based biosensors for immediate sensing signal amplification can significantly suppress the interference from environmental noise and therefore improve overall signal-to-noise ratio of the biosensors [2]. Such noise mitigation approach is particularly important for FET biosensor with downsized channel, *e.g.*, silicon nanowire (SiNW), aiming for large surface-to-volume ratio and therefore high charge sensitivity, as the SiNWFET biosensor operates at low current level and are extremely vulnerable to environmental noise. The LBJT is well-suited in this circumstance as its fabrication can share the same process as that for the SiNWFET sensor.

In this work, we demonstrate NPN-type LBJTs on SOI wafers with $\beta > 60$ using a fully CMOS-compatible process [3]. Systematic investigation on the substrate voltage modulation effects on current-voltage characteristics and low frequency noise of the LBJT will be presented. Potential benefit on β and noise of the LBJT from the substrate voltage modulation will also be analyzed and discussed.

REFERENCES

[1] Tak H. Ning, "A perspective on SOI symmetric lateral bipolar transistors for ultra-low-power systems," IEEE J. Electron Devices Soc., vol. 4, no. 5, pp. 227-235, 2016.

[2] Da Zhang *et al.*, "An ion-gated bipolar amplifier for ion sensing with enhanced signal and improved noise performance," Appl. Phys. Lett., vol. 105, no. 8, p. 082102, 2014.

[3] Qitao Hu *et al.*, "Current gain and low-frequency noise of symmetric lateral bipolar junction transistors on SOI," 48th European Solid-State Device Research Conference, 3-6 Sept. 2018.