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**MoS<sub>2</sub> Transistors Operating at Gigahertz Frequencies**

DARIA KRASNOZHON, DOMINIK LEMBKE, CLEMENS NYFFELER, YUSUF LEBLEBICI, ANDRAS KIS, Electrical Engineering Institute, Ecole Polytechnique Federale de Lausanne (EPFL) — The presence of a direct band gap and an ultrathin form factor has caused a considerable interest in 2D semiconductors from TMD family with MoS<sub>2</sub> being the most studied representative of this family of materials. While diverse electronic elements, integrated circuits and optoelectronic devices have been demonstrated using ultrathin MoS<sub>2</sub> and related materials, very little is known about their performance at high frequencies. We fabricated top-gated MoS<sub>2</sub> transistors operating in the gigahertz range of frequencies. The presence of a band gap also gives rise to current saturation, allowing voltage gain higher than 1. The RF transistors are fabricated from exfoliated MoS<sub>2</sub> with different layer thickness. All our devices presented transconductance typical of n-type materials with on-state current reaching 300  $\mu\text{A}/\mu\text{m}$  for  $V_{\text{ds}} = 2$  V and gate voltage  $V_{\text{tg}} = 10$  V in the case of monolayer MoS<sub>2</sub>. The current gain of the MoS<sub>2</sub> FETs decreases with increasing frequency and shows the typical  $1/f$  dependence. In conclusion, we studied top-gated MoS<sub>2</sub> transistors with a 240 nm gate length. Our MoS<sub>2</sub> RF-FETs show an intrinsic transconductance higher than 50  $\mu\text{S}/\mu\text{m}$  and a drain-source current saturation with a voltage gain higher than 1. Our devices show cut-off frequencies in the GHz range and are able not only to amplify current in this frequency range but also power and voltage, with the maximum operating frequency  $f_{\text{max}} = 8.2$  GHz.

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