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Ultralow voltage (1 μV) electrical switching of SnS thin films driven by a vertical electric field

Mircea Dragoman[1], Daniela Dragoman[2,3], Adrian Dinescu[1], Andrei Avram[1], Silviu Vulpe[1], Martino Aldrigo[1,*], Tudor Braniste[4], Victor Suman[5], Emil Rusu[5] and Ion Tiginyanu[4,6]

[1] National Institute for Research and Development in Microtechnologies, Erou Iancu Nicolae Street 126A, 077190 Voluntari (Ilfov), Romania
[2] Univ. of Bucharest, Physics Faculty, PO Box MG-11, 077125 Bucharest, Romania
[3] Academy of Romanian Scientists, Str. Ilfov 3, 050044 Bucharest, Romania
[4] National Center for Materials Study and Testing, Technical University of Moldova, 168 Stefan cel Mare Av., 2004 Chisinau, Moldova
[5] Institute of Electronic Engineering and Nanotechnologies, Academiei Street 3/3, 2028 Chisinau, Moldova
[6] Academy of Sciences of Moldova, 1 Stefan cel Mare Av., 2004 Chisinau, Moldova

E-mail: martino.aldrigo@imt.ro

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Abstract

In this paper, we show in a series of experiments on 10 nm thick SnS thin film-based back-gate transistors that in the absence of the gate voltage, the drain current versus drain voltage (I_D–V_D) dependence is characterized by a weak drain current and by an ambipolar transport mechanism. When we apply a gate voltage as low as 1 μV, the current increases by several orders of magnitude and the I_D–V_D dependence changes drastically, with the SnS behaving as a *p*-type semiconductor. This happens because the current flows from the source (S) to the drain (D) electrode through a discontinuous superficial region of the SnS film when no gate voltage is applied. On the contrary, when minute gate voltages are applied, the vertical electric field applied to the multilayer SnS induces a change in the flow path of the charge carriers, involving the inner and continuous SnS layer in the electrical conduction. Moreover, we show that high gate voltages can tune significantly the SnS bandgap.

Keywords: 2D materials, bandgap modulation, SnS thin films, ultralow voltage electrical switch

(Some figures may appear in colour only in the online journal)

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Data availability statement

The data that support the findings of this study are available upon reasonable request from the authors.

ORCID iDs

Mircea Dragoman https://orcid.org/0000-0001-6886-5295

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