Growth and Transport study of InSb Nanoflags

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Owing to its low electron effective mass and the narrowest band gap of any III–V semiconductor at room temperature, Indium Antimonide (InSb) appears to be a promising material to investigate the emerging exotic bound states at the superconductor/semiconductor interface.

Following the recent growth processes reported in literature [1,2] we have grown InSb nanoflags by means of Au-assisted Chemical Beam Epitaxy (CBE). The shape transition from nanowire (1D) to nanoflag (2D) has been obtained by tailoring the growth parameters like growth temperature, precursor fluxes, sample rotation, and substrate orientation. The InSb nanoflags have been epitaxially grown on InAs nanowire stems obtained at 415°C using 0.6 Torr of trimethylindium (TMIn) and 1.5 Torr of tertiarybutylarsine (TBAs). The following InSb growth has been carried out at 20° lower temperature and without rotation of substrate. After a first InSb segment grown for 30 mins using 0.6 Torr of TMIn and 2.3 Torr of trimethylantimony (TMSb), the growth has been continued for 30 mins, gradually increasing the TMSb flux from 2.3 to 2.6 Torr, while keeping the TMIn flux constant, in order to increase the lateral growth, achieving the nanoflag shape. Finally, cooling of the sample was performed in vacuum for few mins in the absence of group V flow to prevent Sb accumulation on the sidewalls. The length, width and thickness of the resulting InSb nanoflags measured by scanning electron microscope (SEM) are (1.3 ± 0.2) μm, (282.3 ± 86.5) nm and (103.8 ± 17.2) nm, respectively (Fig. 1). Starting from individual InSb nanoflag dropcasted onto SiO_2/Si^{++} substrates, we have fabricated electronic devices characterized by Hall bar configuration (top inset of Fig. 2). At low temperature (4.2 K), electron concentration and mobility of the order of 10^{16} cm^{-2} and 10^4 cm^2/Vs were measured, respectively. The transconductance of our devices was measured operating the substrate as a back-gate and displays full modulation of the electronic channel within an applied gate voltage window of ~40 V (bottom inset of Fig.2). Preliminary magneto-transport results suggest the onset of weak antilocalization effects.

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[2] D. Pan, D. X. Fan, N. Kang, J. H. Zhi, X. Z. Yu, H. Q. Xu, J. H. Zhao, Nano Lett., **2016**, 16 (2), pp 825–833

Fig. 1

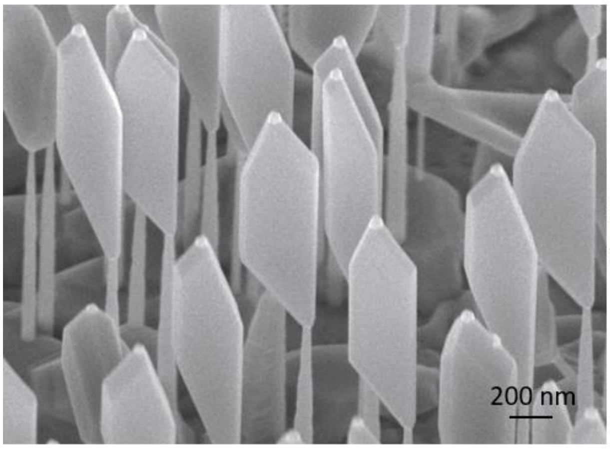

Fig. 2

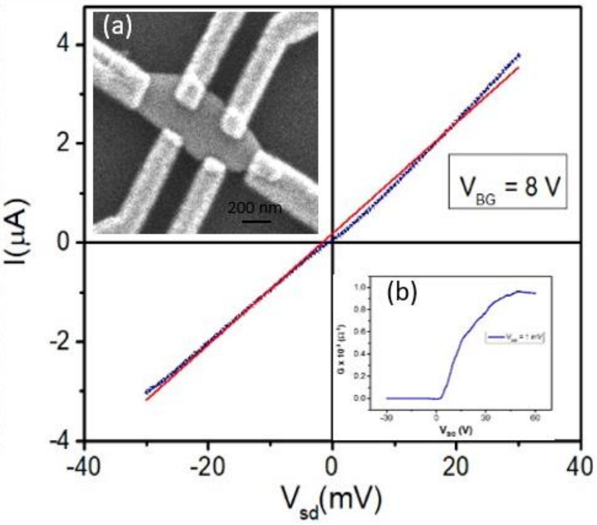

Figure 1: InSb Nanoflags: SEM image (45° tilt) of InSb Nanoflags. Figure 2: Current- Voltage characteristics measured at 4.2 K and with a back gate voltage V_{BG} = 8V. Top inset (a): SEM image of fabricated device in Hall bar configuration. Bottom inset (b): Trasconductance ,G as a function of V_{BG} at 4.2 K.