Supplementary material

Ag-catalyzed GaSb nanowires for flexible near-infrared photodetectors

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Experimental details

Nanowire growth: GaSb nanowires (NWs) studied in this work are prepared by a surfactant-assisted CVD method in a dual-zone horizontal tube furnace. Generally, the high purity source powder is placed in the upstream zone, the Si/SiO_2 growth substrate with Ag-catalyst is placed in the downstream zone, and sulfur powder lies between the two zones. Hydrogen (99.999% purity) acts as a carrier gas to transport the upstream precursor steam to the downstream zone. The CVD system is pumped to 6×10^{-3} Torr and then purged with 200 sccm H_2 for 0.5 h before heating. When it reaches the set time, the source and substrate heater stop together and cool to room temperature under the hydrogen flow.

Material characterizations: The morphology of the as-prepared GaSb NWs is characterized by scanning electron microscope (SEM, Thermo Scientific Helios G4 UC). The crystal phase and phase purity of as-prepared NWs are verified by X-ray diffraction (XRD, D8 Advance, Bruker). The microstructure and composition characterizations of as-prepared GaSb NWs are studied by a high-resolution transmission electron microscope (HRTEM, JEOL JEM-F200).

Devices Fabrication: The preparation of back-gated NWFETs is as follows. First, the as-prepared GaSb NWs are suspended in ethanol solution by ultrasonication and then drop-cast onto the heavily doped p-type Si substrates with a 50 nm thick SiO_2. Then, the source/drain electrodes are patterned by UV photolithography, and a 50 nm thick Ni film is thermally deposited as the source/drain electrodes followed by a standard lift-off process. The preparation of flexible photodetector is as follows. First, the as-prepared GaSb NWs are suspended in ethanol solution by ultrasonication and then drop-cast onto the PI substrates. Then, the source/drain electrodes are patterned by UV photolithography, and 3 nm Cr/50 nm Ni film are thermally deposited as the source/drain electrodes followed by a standard lift-off process.

Device Measurements: Electrical performances of the fabricated back-gated NW FETs and photodetection performance of as-fabricated GaSb NW photodetector are characterized by a standard electrical probe station and an Agilent B1500A semiconductor analyzer in an atmospheric environment. Agilent B1500A semiconductor analyzer serve as the current signal acquisition equipment and diode lasers serve as the light sources. The waveform generator controlls the power supply system of the diode laser to output periodic optical signals, and the optical fiber leads the light into the probe to illuminate the device. The laser intensity is calibrated by a power meter.

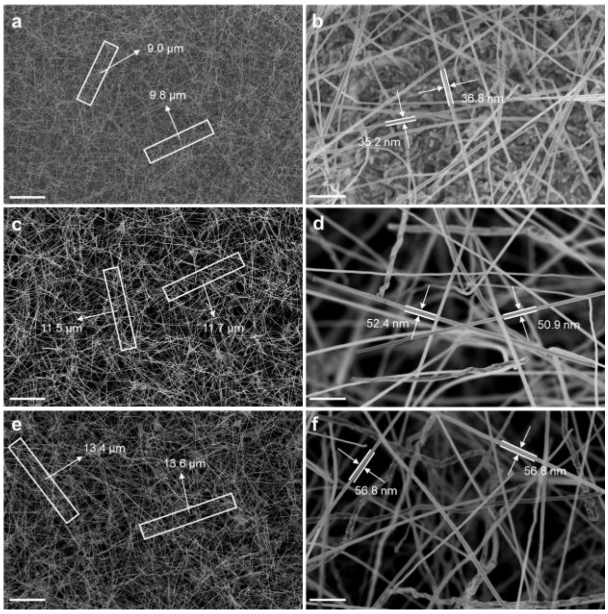

Fig. S1. Morphology of Ag-catalyzed GaSb NWs. SEM images of GaSb NWs grown by (a, b) 0.1 nm Ag, (c, d) 1.0 nm Ag and (e, f) 2.5 nm Ag as catalyst. The scale bars of (a, c, e) are 5 μm; The scale bars of (b, d, f) are 500 nm.

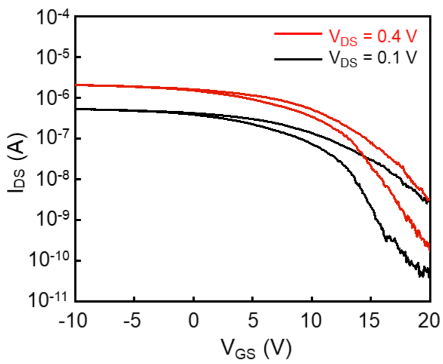

Fig. S2. Logarithmic transfer characteristics of as-constructed GaSb NWFET.

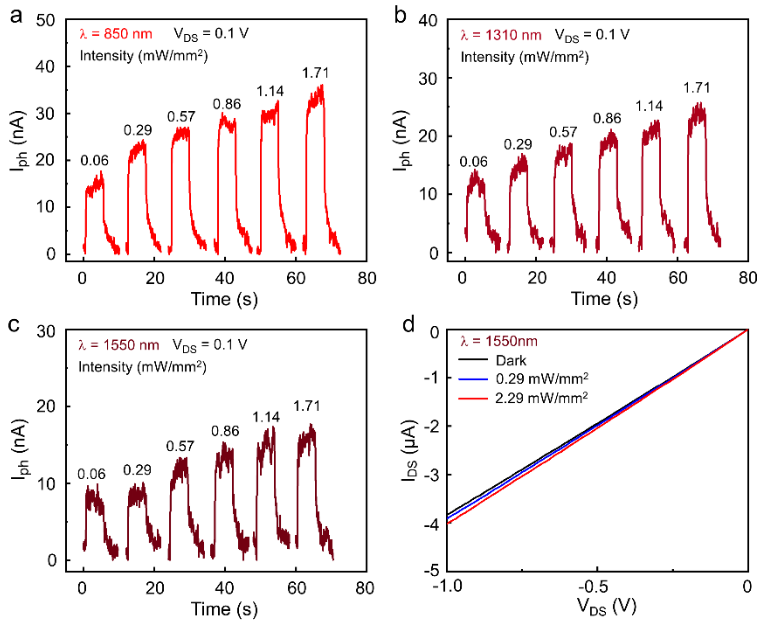

Fig. S3. NIR photodetection behaviors of as-prepared Ag-catalyzed GaSb NWs. (a,b,c) Time-resolved photoresponse of GaSb NW photodetector under the illuminations of 850 nm, 1310 nm and 1550 nm lasers, respectivily. (d) Static detection performance of GaSb NW photodetector under the illumination of 1550 nm laser.

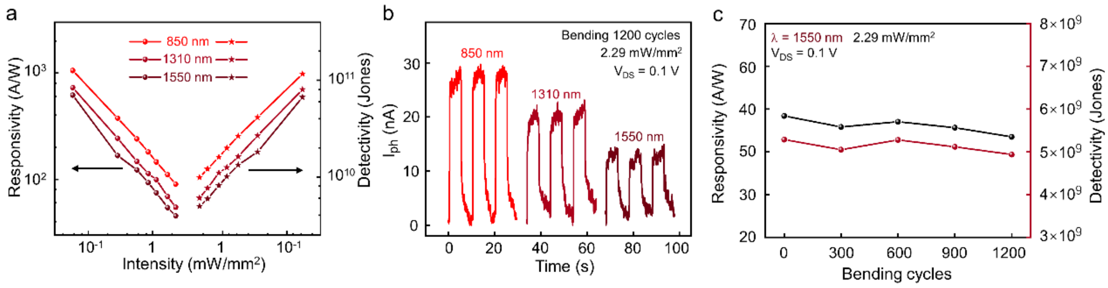

Fig. S4. Photoresponse behaviors of as-fabricated GaSb NW flexible photodetector. (a) The ependence relationship of responsivity and detectability on light intensity. (b)Time-resolved photoresponse of GaSb potodetector after 1200 bending cycles. (c) R and D* of photodetector under the illumination of 1550 nm laser with intensity of 2.29 mW/mm^2 after different bending cycles.