Supplementary information for: Terahertz conductivity of silver nanowire layers

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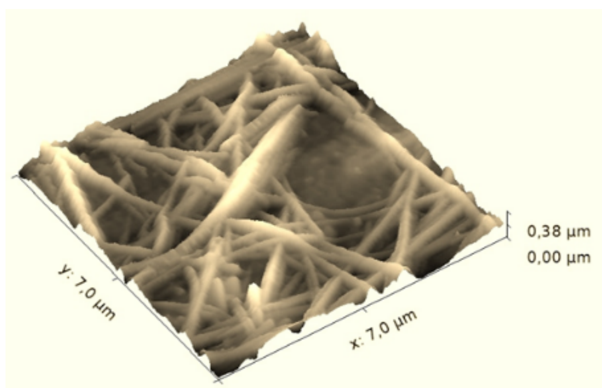

Figure S1. AFM image of the AgNWs network.

Terahertz time-domain spectroscopy system

An infrared femtosecond laser generates a series of pulses with a 1040 nm central wavelength, 200 fs pulse duration, 70 MHz repetition rate, and 15 nJ pulse energy. The laser beam is split into a probe beam and a pump beam with an energy ratio of 10% to 90%. The optical path of the pump beam is controlled by an optical delay line and modulated by a chopper at 667 Hz. The THz radiation is generated in an InAs crystal (in a magnetic field of 2 T). After passing through an IR filter, the THz beam incidents on the sample and reaches the CdTe semiconductor detector. The probe beam passes through a half-wave plate, a Glan prism, and meets with the THz beam on the CdTe surface. The polarization of the probe beam varies proportionally to the THz wave amplitude at a given time point, depending on the position of the time delay line. The beam is split into two orthogonally polarized components by a Wollaston prism and detected with balanced photodiodes.

Terahertz frequency-domain spectroscopy system

The CW-THz spectrometer contains two distributed-feedback diode lasers (laser 1 and laser 2) working in the system using the photomixing technique, where the generated THz signal is equal to the frequency of the laser heterodyne [1*, 2*]. Scanning of the THz frequency is achieved by cooling one while heating the other laser, which tunes the wavelength around the central value of 1.5 µm. Both lasers are combined to the beating signal via a 50:50 fiber coupler. The beating signal is split into the emitter

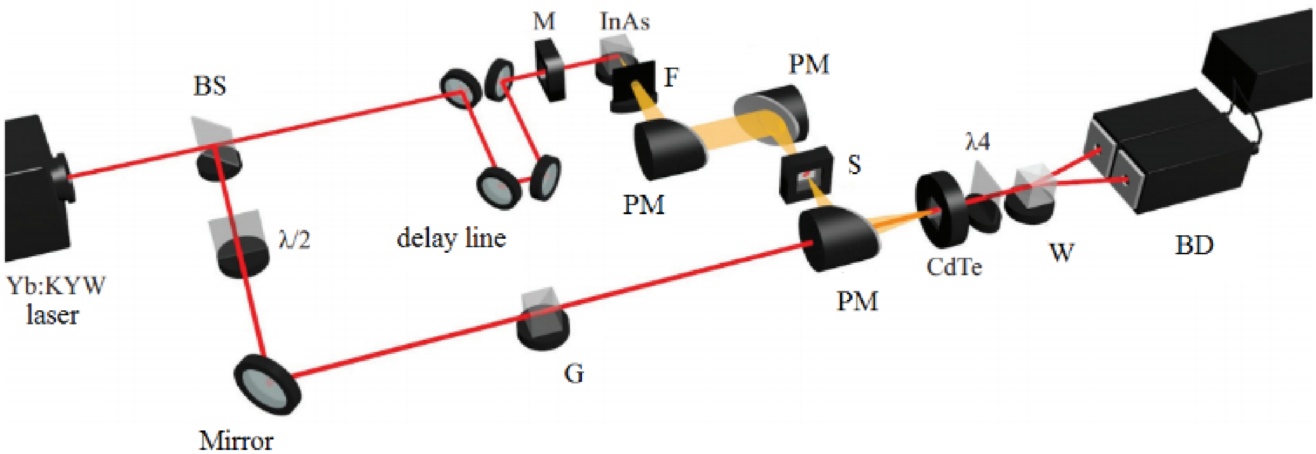

Figure S2. Schematic diagram of the THz-TDS system. BS – beam splitter, M – modulator, F – IR filter, S – sample, PM – parabolic mirror, G –Glan prism, W –Wollaston prism, BD – balance detector.

(Tx) and the receiver (Rx) branch. The beat can be varied continuously from 0 to 1.2 THz [2*]. However, the low-frequency limit of the CW spectrometer is around 50 GHz and is based on the difficulty of our interpretation of receiving data. The laser beating signal is transformed via a self-complementary broadband antenna on InGaAs photodiode into a terahertz wave [2*]. The photomixers are placed on a hyper-hemispherical silicon lens, which suppresses back-reflections and pre-collimates the THz radiation in free space. The emitter is gated with a signal DC bias and a modulation AC lock-in signal. The receiver is connected to a lock-in signal amplifier. The bare substrate without nanowires and a silicon wafer were measured for reference (see Figure S3).

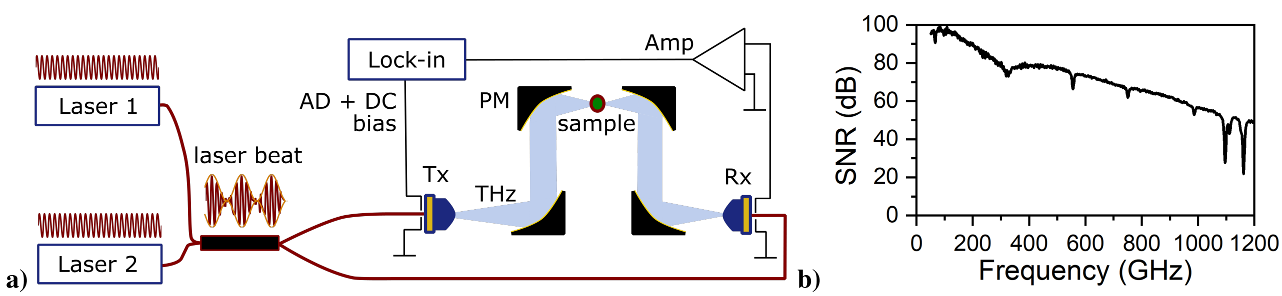

Figure S3. a) Schematic diagram of the THz-CW spectrometer. Tx – emitter, Rx – receiver, PM – parabolic mirror. b) The signal-to-noise ratio of the system.

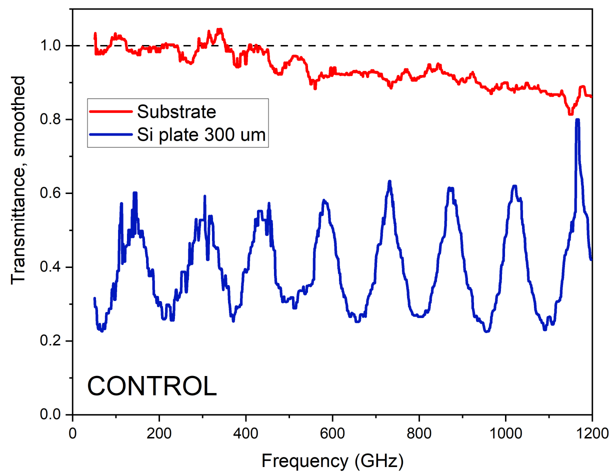

Figure S4. Measured transmittance of a bare substrate and a silicon wafer as reference.

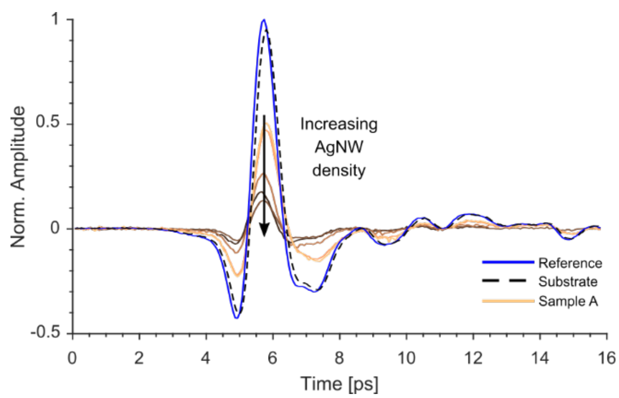

Figure S5. Measured time-domain THz pulses through the air as a reference, the substrate, and several samples A with different nanowire densities.

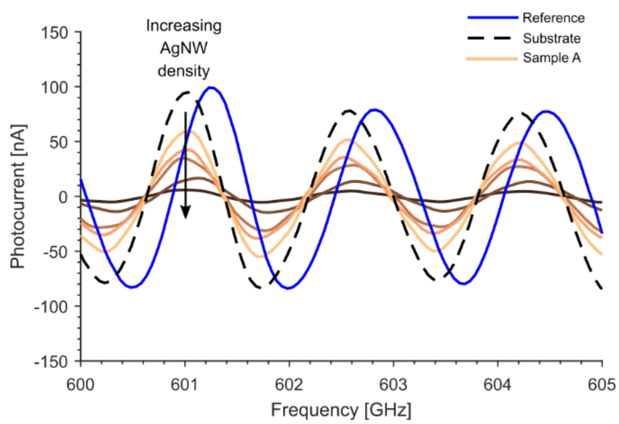

Figure S6. Measured frequency-domain THz photocurrent (zoomed to a small frequency range for better visibility) through the air as a reference, the substrate, and several samples A with different nanowire densities. The spacing between maxima indicates a spectral resolution of 2 GHz.