Electronic Supplementary Material (ESI) for Nanoscale.

SUPPORTING INFORMATION

Highly stretchable, printable nanowire array optical polarizer

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Transmission measurement set up

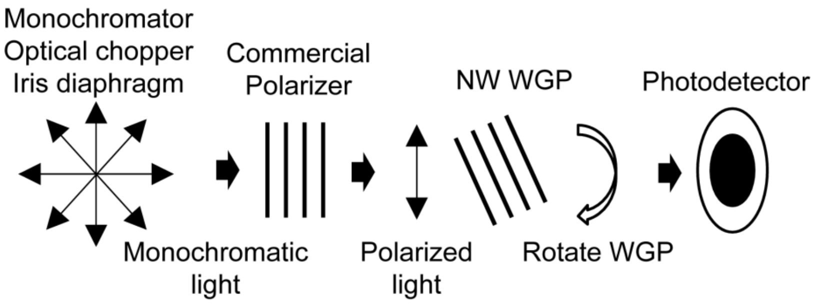

Fig. S1 Diagram of transmission measurement set up

The transmission data was collected using monochromator (Horiba Jobin Yvon iHR550) equipped with 1200 groove/mm grating and 330 nm blaze combined with calibrated photodetector (Newport), lock-in amplifier (SR530), and 100 W halogen lamp (Osram 64628) as an incident light source. As described in Fig.S1, polarized monochromatic light source with 0.5×0.5 mm spot size is created by incoming light pass through series of monochromator, optical chopper, iris diaphragm, and commercial polarizer mounted on an optical table with all components aligned along the optical axis. Optical chopper is synchronized with the lock-in amplifier to provide an accurate and stable reference frequency. NW WGP is mounted on a rotatable stage and finally the light intensity is detected by the photodetector. Prior to the measurement on NW WGP, reference spectrums are obtained on a blank PET or PDMS sheet to extract the substrate effect.

NW pitch distance versus TE spectra minima and effective reflective indices

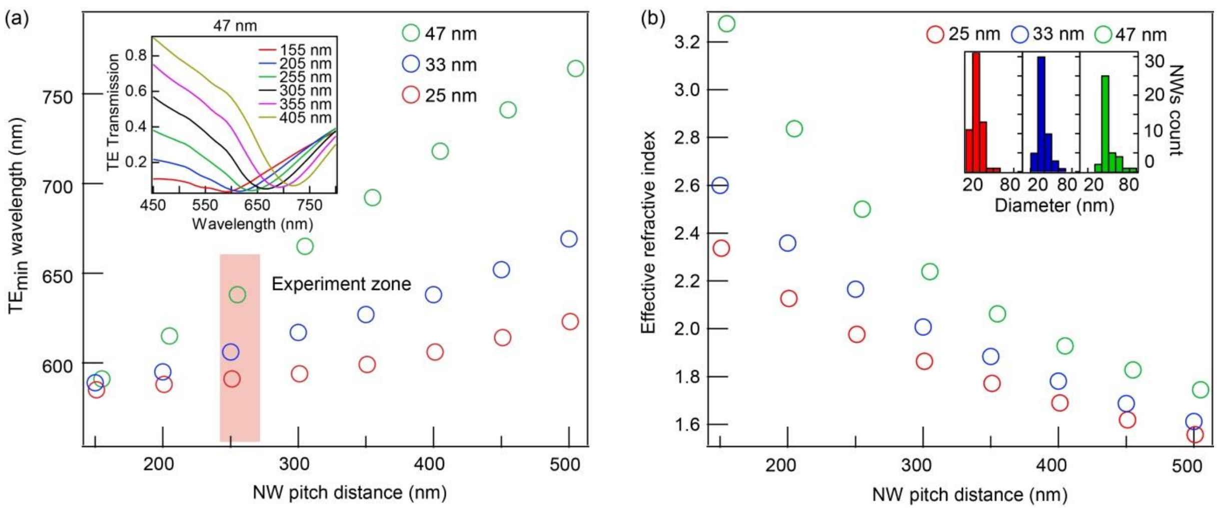

Fig. S2 Effect of varying NW pitch distance on (a) location of TE spectra minima and (b) effective refractive indices, $n_{eff} = \sqrt{F n_{Ge}^2 + (1-F) n_{air}^2}$, for three different NW diameters where F is the fill factor of Ge array and n_{Ge} and n_{air} are the refractive index of Ge NWs and air, respectively. All three curves in figure (a) show red shift while larger increment is observed with increasing of NW diameter. Three experiment samples are located within the highlighted red box. Inset of (a) shows the trend of TE spectrum shift for 6 different periods of NW array in case of NW diameter of 47 nm in average. In figure (b), changes of n_{eff} are more dramatic for larger NWs which may correspond to the slope of TE_{min} shift. Inset of (b) shows the diameter distribution of three samples used for experiment where the mean values are located at 25 nm, 33 nm, and 47 nm respectively.

NW-PDMS WGPs measurement as a function of strain

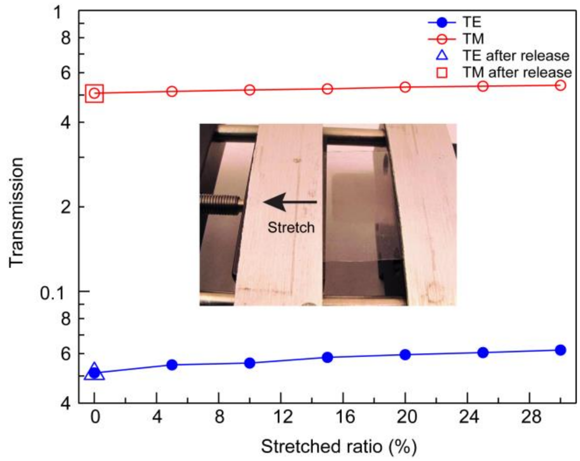

Fig. S3 Stretching test on NW-PDMS WGP. Transmission of NW WGP is measured with 6 steps of stretching from 0% to 30% of strain. After 30% of stretching the sheet is released back to non-stretched state indicated by empty square and triangle markers.

Transmission spectra comparison between Ge and Ge/Si core/shell NWs

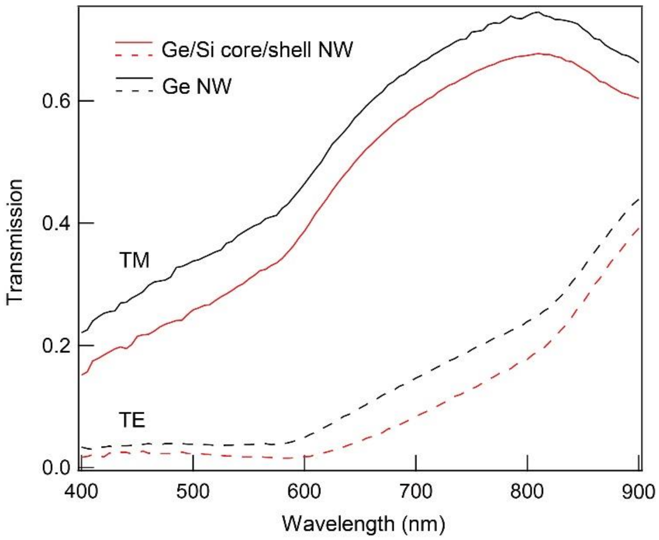

Fig. S4 Comparison of TM and TE spectra between Ge NWs and Ge/Si core/shell NWs. Both NW polarizers show similar light response behaviors indicating Ge core dominantly affects the overall spectrum profile.

Perspective of NW-PDMS polarizer to improve the performance

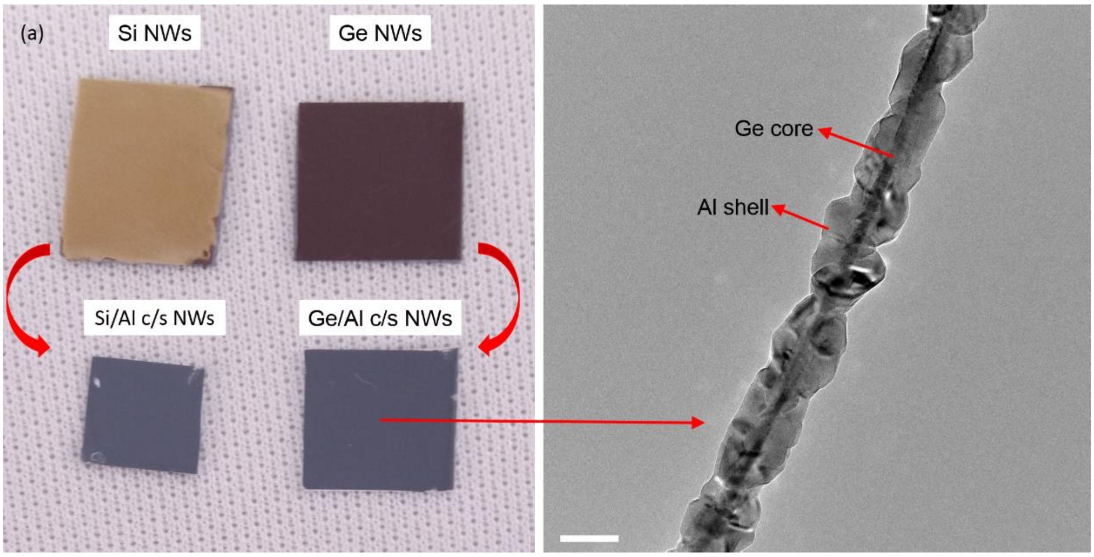

Fig. S5 Modification of as-grown Si or Ge NWs into metal/dielectric core/shell (c/s) NWs to improve the performance of NW-PDMS polarizer. (a) A photography of before (top two substrates) and after (bottom two substrates) shell coating by sputtering. Both Si and Ge NWs turn to grayish from their pristine yellow and red colors indicating light interaction is dominated by the metal shell. (b) TEM image of Ge/Al core/shell NWs. Scale bar is 100 nm.