ADVANCED MATERIALS

Supporting Information

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Giant Poisson's Effect for Wrinkle-Free Stretchable Transparent Electrodes

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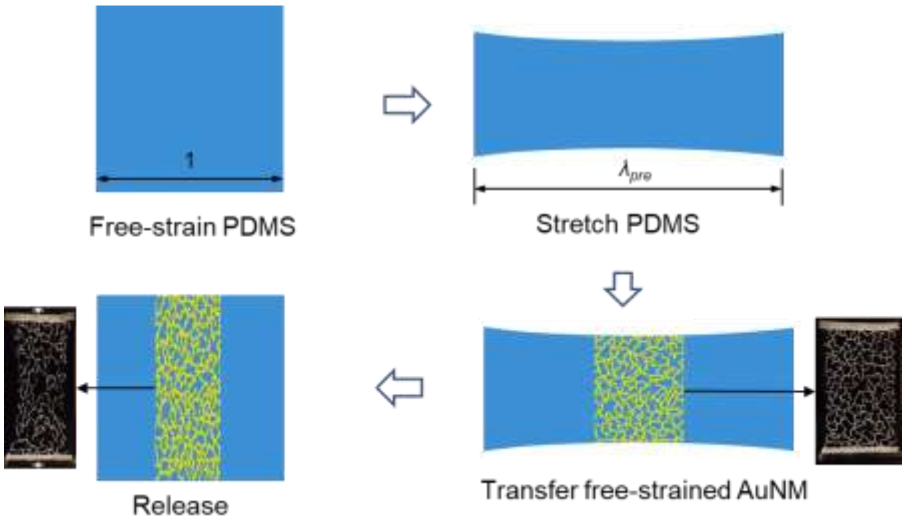

Figure S1. Schematic of the transfer of a mesh on a pre-strained substrate.

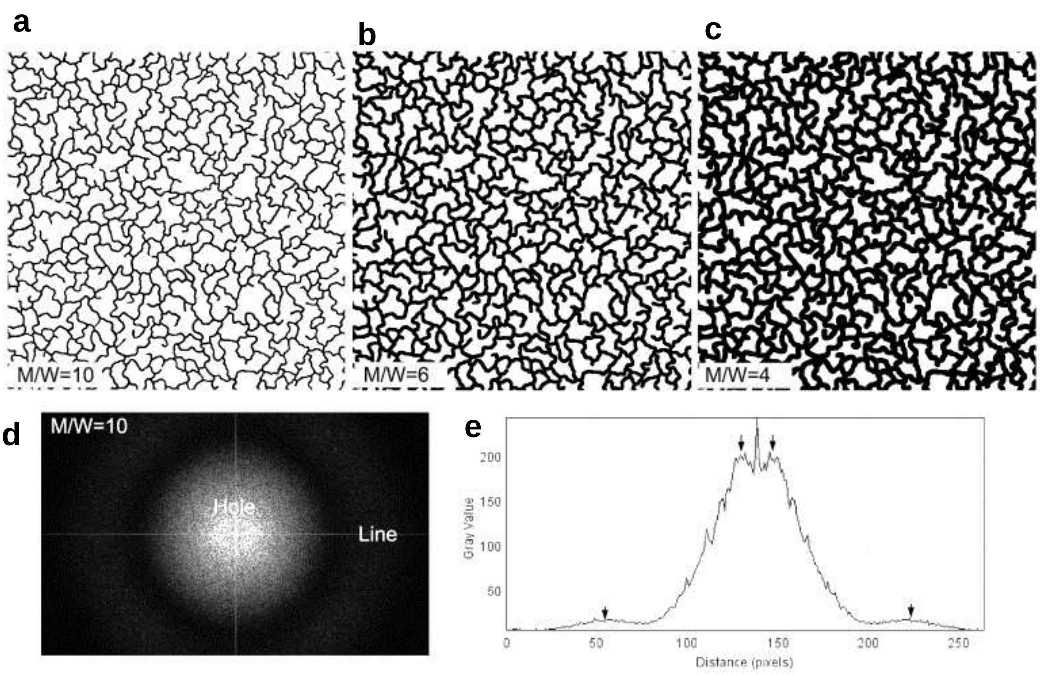

Figure S2. Determination of *M/W*. (a)-(c) Meshes with *M/W* ratios of 10, 6, and 4, respectively. (d) Fourier transformation pattern of a mesh with a *M/W* ratio of 10. (e) Intensity spectrum of the pattern in panel (d).

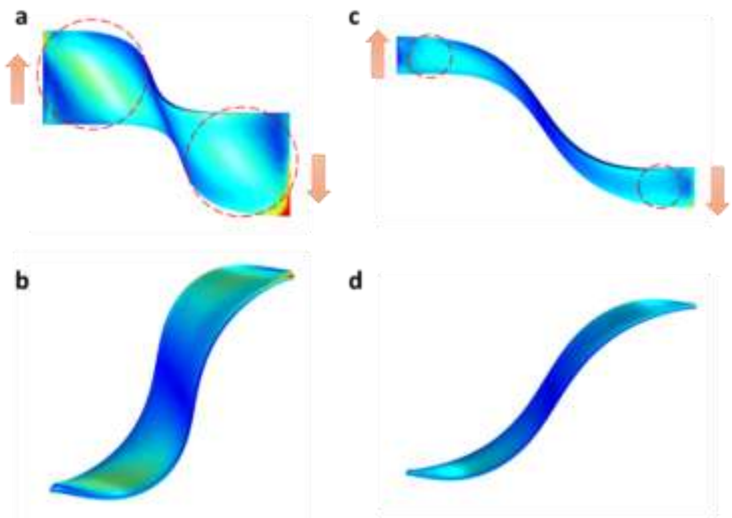

Figure S3. Out-of-plane deformation of thin filaments. (a) Top and (b) side views of the deformed shape of a filament with a relatively small aspect ratio (*M/W*=4) and those (c and d, respectively) of a filament with a relatively large aspect ratio (*M/W*=10). The regions with sizes comparable to the widths of the filaments exhibit significant twisting, as indicated by dashed circles in (a) and (c). The color scale shows the relative von Mises stress level, with longer wavelength colors indicating greater stress.

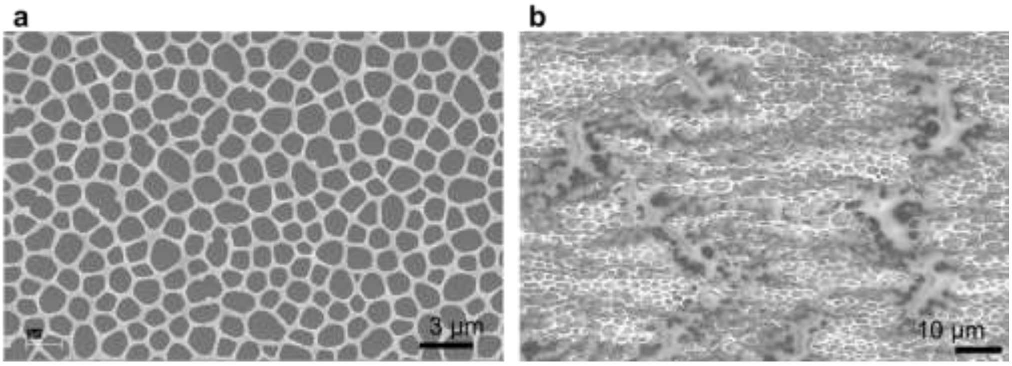

Figure S4. (a) Perforated Au film made by using a phase-separation method. (b) Wrinkles are generated with the formation of cracks upon releasing from a pre-stretched state.

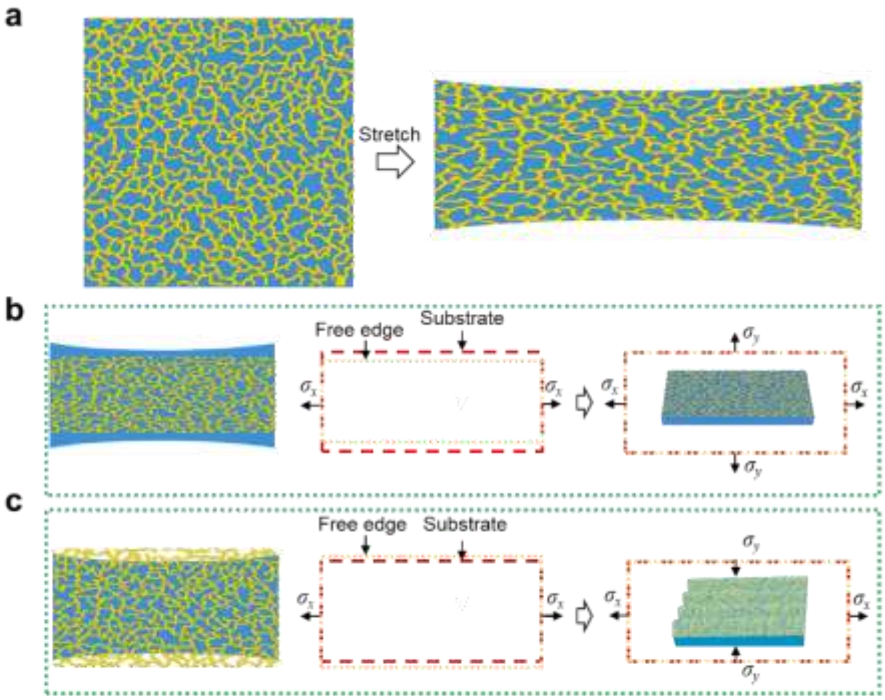

Figure S5. Mechanism for the formation of wrinkles or for being wrinkle-free in a AuNM/PDMS bilayer under uniaxial stretching. (a) Schematic for the real case in which the mesh co-deforms with the substrate. If the mesh is free along the y-direction, the stress states in the cases where the effective Poisson's ratio is (b) larger and (c) smaller than 0.5 (the Poisson's ratio of the substrate). When the Poisson's ratio is larger than 0.5, or the lateral contraction of the mesh is smaller than that of the substrate, no wrinkles would form during stretching.

Figure S6. Optical image of a pre-strained 7-nm-thick Au film (λ_{pre}=1.5). The substrate is PDMS. The scale is about 3 cm×5 cm.

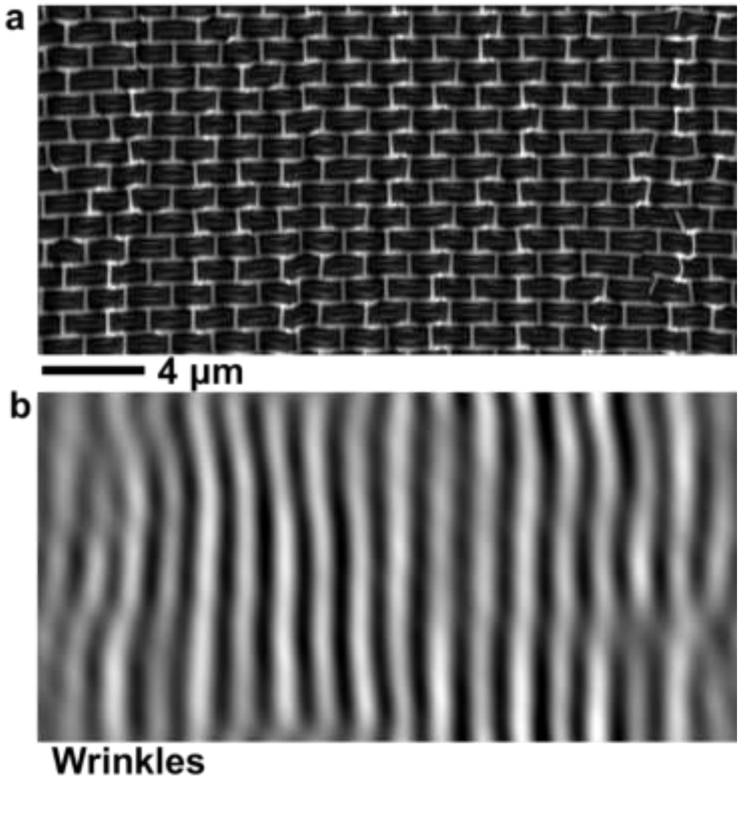

Figure S7. A Au network-PDMS bilayer with λ_{pre}=1.1 (falling within the wrinkling regime), showing surface wrinkles perpendicular to the pre-stretching direction. (a) An original SEM image. (b) The corresponding inverse fast Fourier transformation image by filtering the metal mesh image. The orientations of the wrinkles can be well identified. The images also show that the wrinkles and the network have different periods.

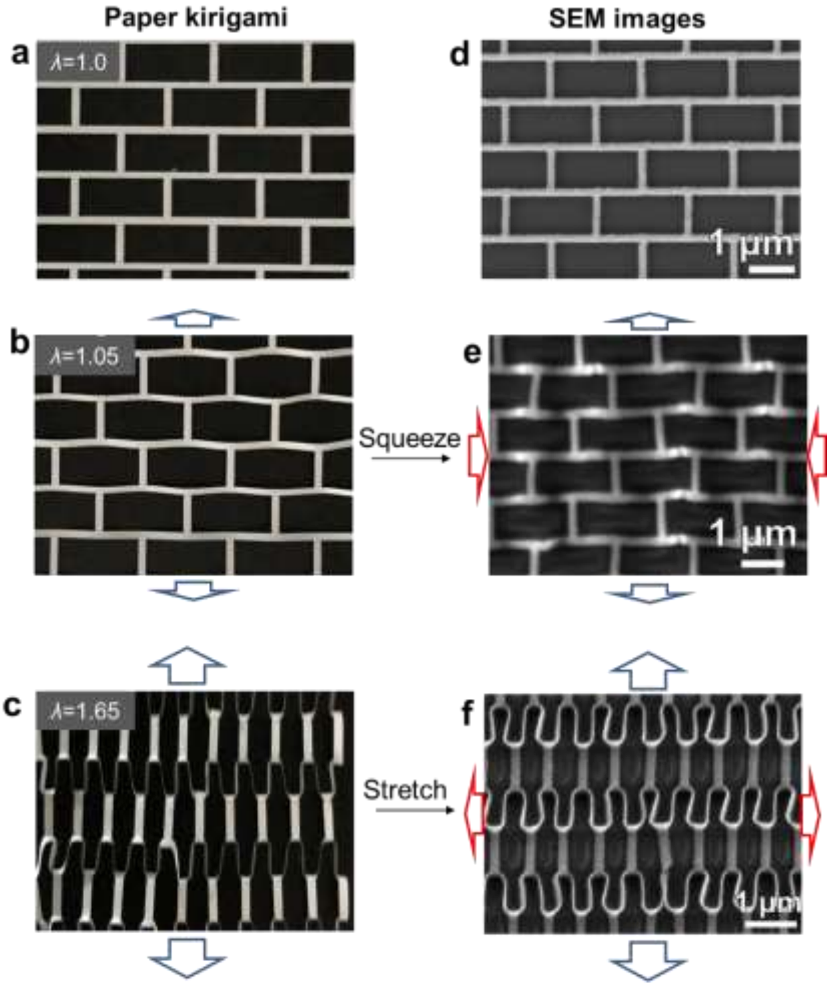

Figure S8. (a)-(c) Free-standing paper kirigami with λ=1.0, 1.05 (corresponding to the network with λ_{pre}=1.1 in Figure 4d), and 1.65 (corresponding to the network with λ_{pre}=2.7 in Figure 4e), respectively. According to Figure 4b, the network at λ=1.05 falls within the wrinkling regime (or the effective Poisson's ratio is smaller than the critical value), but changes to the non-wrinkling regime as λ increases to 1.65. (d)-(f) SEM images of the Au network on pre-stretched PDMS corresponding to λ_{pre}=1.0, 1.1, and 2.7, respectively. The substrate plays an important role for regulating the morphology of the Au nano-network. For the case of λ_{pre}=1.1 (panel (e)), the effective Poisson's ratio of the structure is smaller than the critical value, and thus the substrate squeezes (red arrows) the Au network to form surface wrinkles. It should be noted that the patterns in panels (b) and (e) are different. However, for the case of λ_{pre}=2.7 (panel (f)), the system falls within the non-wrinkling regime, and the substrate stretches the network biaxially, such that the kirigami pattern can be maintained (although being slightly widened).