Supplementary Information for

Highly sensitive and selective multidimensional resistive strain sensor based on stiffness-variant stretchable substrate

Sun-Hyung Ha,[a] Sung-Hun Ha,[a] Mun-Bae Jeon,[b] Ji Hwan Cho[c] and Jong-Man Kim*[a,d]

[a] Department of Nano Fusion Technology and BK21 Plus Nano Convergence Technology Division, Pusan National University, Busan 46214, Republic of Korea.
[b] Department of Nanomechatronics Engineering, Pusan National University, Busan 46214, Republic of Korea.
[c] Department of Electronics Engineering, Pusan National University, Busan 46214, Republic of Korea.
[d] Department of Nanoenergy Engineering, Pusan National University, Busan 46214, Republic of Korea. *E-mail: jongkim@pusan.ac.kr

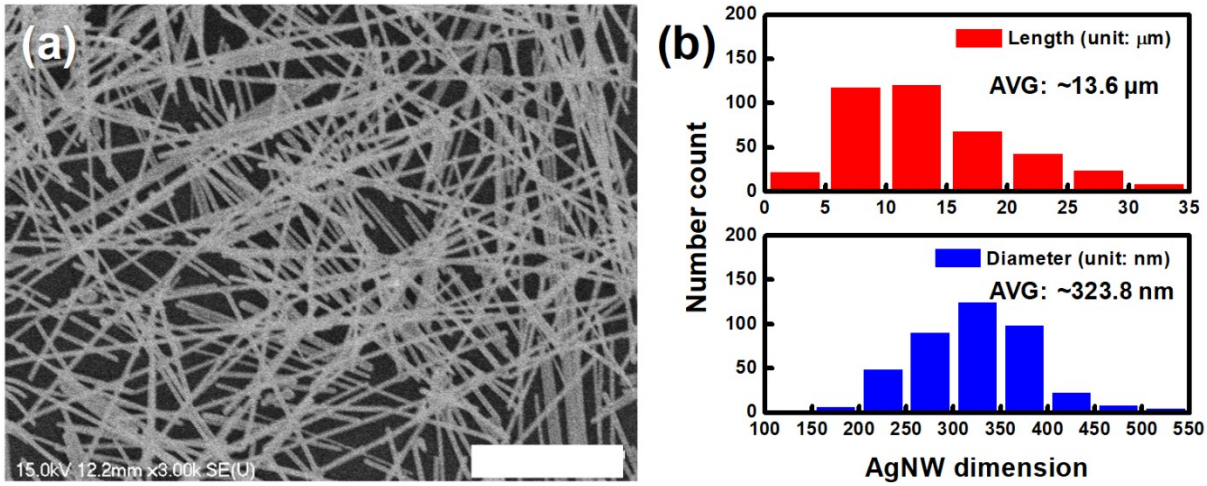

Fig. S1 Synthesized AgNWs. (a) SEM image of the synthesized AgNWs showing typical dimensions, scale bar: 10 μm, and (b) length and diameter distributions of the synthesized AgNWs representing the average length of ~13.6 μm and diameter of ~323.8 nm (400 AgNWs measured).

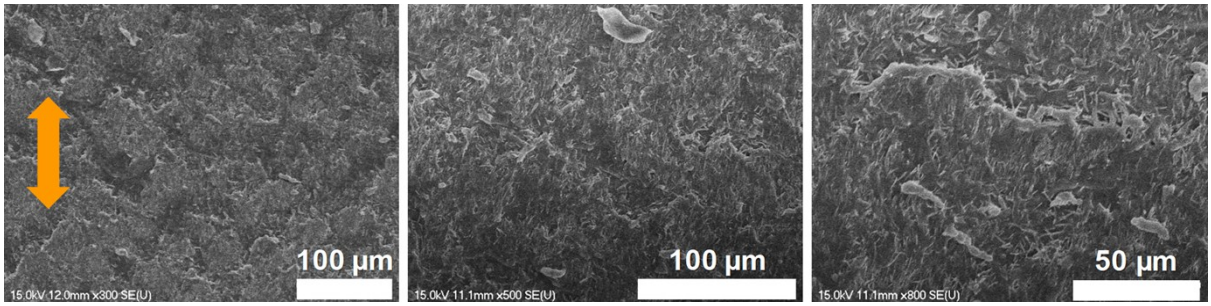

Fig. S2 Surface morphology of the AgNW sensing film on the soft part under 50% tensile strain at various regions (The arrow indicates the stretching direction for all SEM images.).

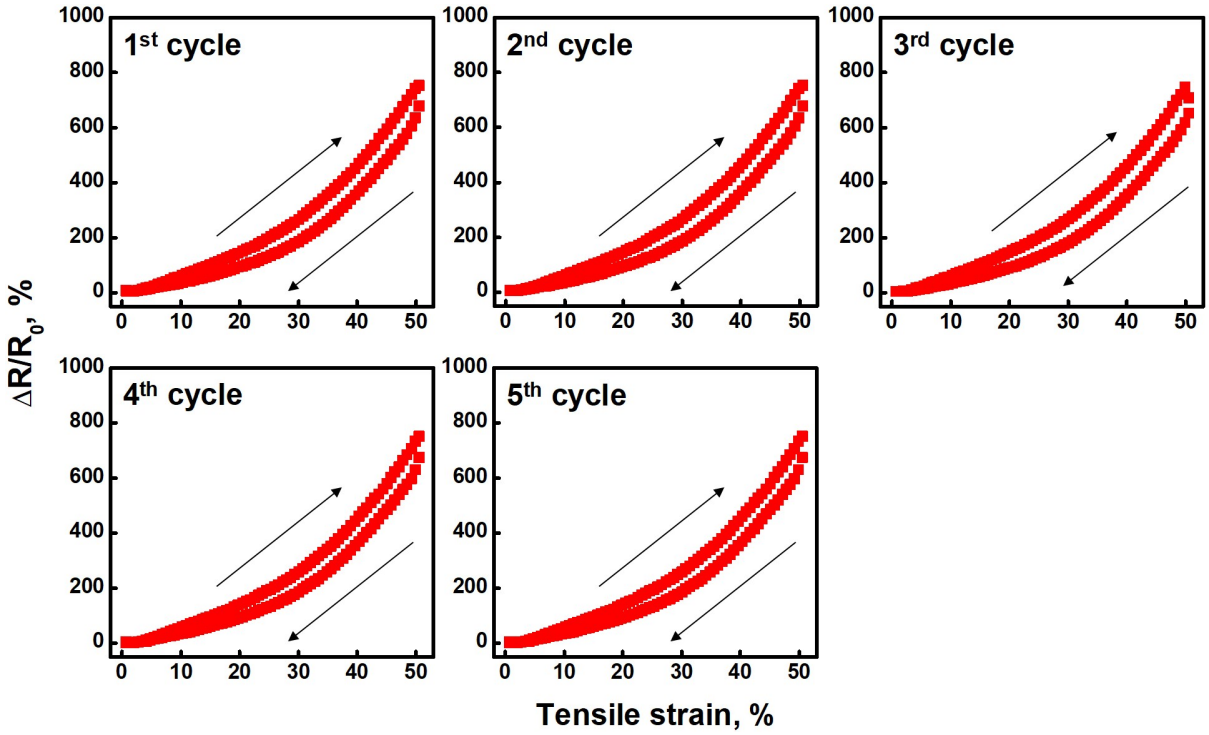

Fig. S3 Hysteresis characteristics of the multidimensional strain sensor.

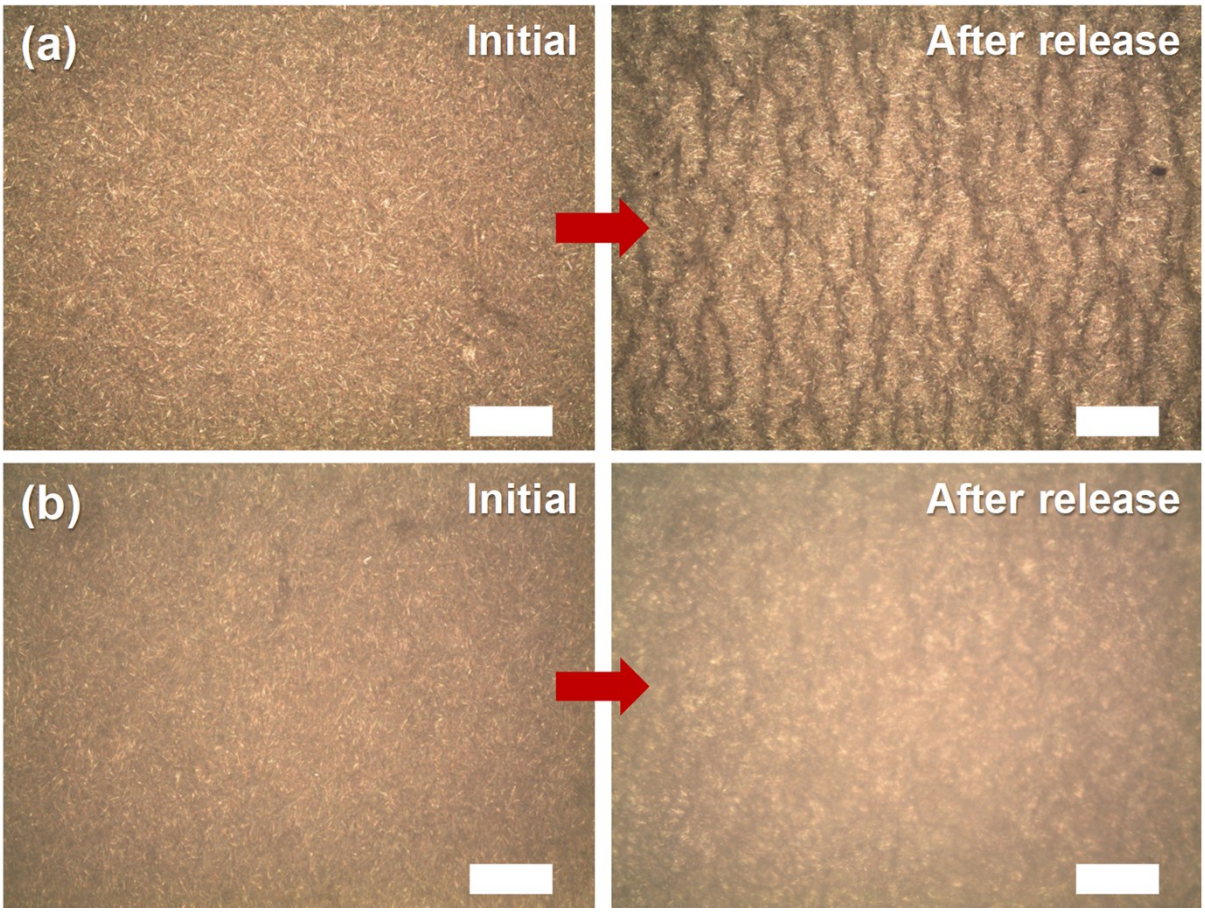

Fig. S4 Top-view OM images of the AgNW sensing film (a) without and (b) with the top protection elastomer layer in the initial and released states, scale bars: 100 μm.

The effect of the top protection elastomer layer on the buckling formation on the surface of the AgNW sensing film was investigated by comparing the surface morphologies of the AgNW films with and without the protection layer in the initial and released states, as shown in Fig. S4. In the case of the sensing film witout the protection layer, substantial surface buckling (wrinkling) was observed on the surface after several stretching/releasing cycles at 60% (Fig. S4a). This might be due to the friction force between the NWs and elastomer matrix during release.[1,2] However, even under the same conditions, the surface buckling was found to be greatly reduced after coating the protection elastomer layer on the top surface of the AgNW film (Fig. S4b). This suggests that the top protection layer played an important role in increasing the resistance to surface buckling as well as in ensuring the mechanical robustness of the device, thereby resulting in high stability and reversibility of the sensing performance.[2]

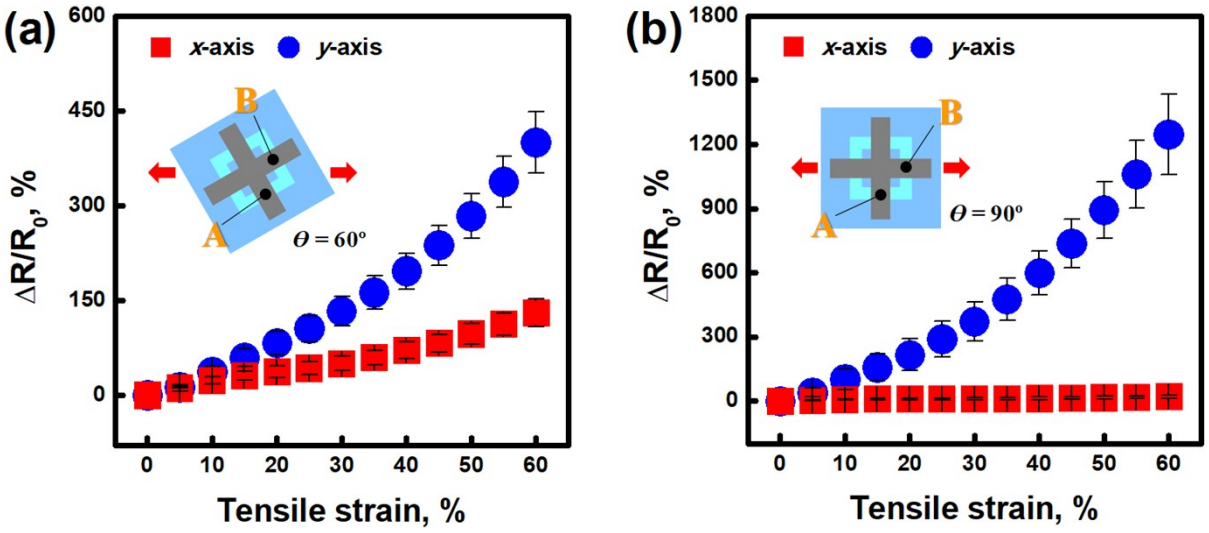

Fig. S5 Resistance change ratio ($\Delta R/R_0$) of the sensor under tensile strain of up to 60% in the direction of (a) Θ = 60° and (b) Θ = 90°.

References

1 F. Xu and Y. Zho, *Adv. Mater.*, 2012, **24**, 5117–5122.
2 M. Amjadi, A. Pichitpajongkit, S. Lee, S. Ryu and I. Park, *ACS Nano*, 2014, **8**, 5154–5163.