Supporting Information

Commercial Silk-Based Electronic Yarns Fabricated Using Microwave Irradiation

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Figure S1. SEM images of cross-section for (a) CS, (b) P650, and (c) M650 at different magnifications.

Although the diameter was gradually reduced as heat treatment and microwave irradiation, no cracks and defects were observed. We confirmed that the diameters of single fiber were about 10 μm for CS, 8 μm for P650, and 5 μm for M650.
Figure S2. Electrical conductivity of the P650 and M650s.

We found that the electrical conductivities of the M650s were exhibited between $10^1$ and $10^2$ S/cm (average conductivity is $1.10 \times 10^2$ S/cm), which improved up to 5 orders compared with the P650. In addition, it was also demonstrated that the experimental procedure was stability and reproducibility.
Figure S3. Each bending degree corresponding to the position (a) 1, (b) 3, and (c) 5 for bending position-dependent conductance measurement of the M650. The positions from 1 to 5 indicated that the bending degree was gradually increased from 0 ° to 90 °.
Figure S4. (a) SEM images of the M650 after 650 bending cycles. The red box indicate the bent part in the M650. (b) SEM images of yellow box area with higher magnifications.

We observed that the morphology was similar to that of before the bending cycles (Figure 1f in the manuscript). It means that the M650 was very stable and durable under bending.

Figure S5. (a) SEM images of knotted M650 with (b, c) different magnifications.
Figures S6a and S6b show the homemade bending device. The device consists of Arduino, step motor, and two electrodes. Arduino controls the speed, interval of the motor using programing language. One electrode is fixed and the other is connected with the motor which can be moved to control the bending degree. When the motor moves, the curvature of the sample changes according to the interval of the electrode as shown in Figure S3. The electrical characteristics were measured by SCS-4200 Semiconductor Characterization System (Keithley) during moving the electrode.
To demonstrate the utilization as an electronic yarn, the M650 was stitched into a commercial silk fabric (3 cm x 2 cm) as shown in Figure S7a. We found that the M650 was very suitable for sewing due to its flexibility (Figure S7b). The stitched M650 was also connected with a blue LED lamp to confirm the electrically conducting property (Figure S7c). The lighted LED lamp indicates that the electrically conducting behavior is stable even after sewing. As a result, it was determined that the M650 has both flexibility and electrical conductivity.

**Figure S7.** Optical images of (a) the M650 and (b) bent M650 stitched into the commercial silk fabric. (c) The M650 with the commercial silk fabric connected to the blue LED.