Advanced microsystem based on bio-degradable/dissolvable materials

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Context

In recent years, a new electrification-based mechanism called triboelectric generator (TEG) has been demonstrated as a stable and renewable power source to convert ambient energy into remarkable electrical output [1-3]. In order for TEG to make an impact in real life applications, further improvement is needed in particular in the choice of the pair of electrification materials beyond the choice of traditional materials that have been employed in the construction of TEGs

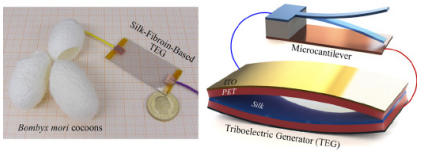

Fig. 1 Photograph of the silk-based triboelectric generator (TEG) and schematic view of driving a microscale cantilever by using the fabricated TEG.

Objectives & Methods

The current purpose of the project is investigating silk fibroin as a novel material for TEG that occupies a top tier position in the triboelectric series and possesses the outstanding ability of losing electrons easily. Furthermore, we are trying to introduce two advantages of silk fibroin into the development of TEGs: remarkable transparency in the visible spectrum region and perfect solubility in aqueous solutions.

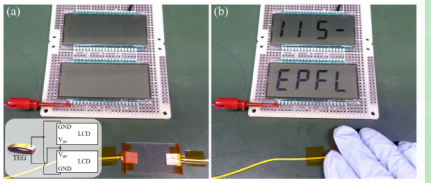

Fig.2 Two 4-bit liquid crystal displays were successfully directly driven by the fabricated triboelectric generator (TEG) without any external circuit.

Results

A novel multi-layer hybrid material based dissolvable silk fibroin material was successfully prepared and showed higher than 90% transmittance in the visible spectrum region. Subsequently, the fabricated TEG exhibits stable high-output performance, with maximum voltage, current, and power density of 268 V, 5.78 μA, and 193.6 μW/cm2, respectively, to a match load of 40 MΩ. This work shows an attractive potential to realize fully-integrated smart transducers that are needed for autonomous sensor networks. [4]

References

[1] F.R. Fan, et al. Nano Energy, 2012, 1, 328-334.
[2] Z.L. Wang. ACS Nano, 2013, 7, 9533-9557.
[3] X.S. Zhang, et al. Nano Energy, 2015, 11, 304-322.
[4] X.S. Zhang, et al. Nano Energy, 2016, 20, 37-47.