

PERTAB RAI

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Abstract

Tactile sensation in human skin is performed by specialized cells called **mechanoreceptors**. Factors such as surgical procedures, skin burns, injury, and nerve damage may lead to impaired sensation. For these reasons, various methods and approaches are developed to revive tactile sensation. In this poster, a step-by-step procedure to synthesize **nanofibers** for the development of artificial tactile sensor is presented.

Keywords: Tactile, Mechanoreceptors and Nanofibers

Introduction

- Human skin is the largest organ in the human body. Underneath the skin are four cutaneous mechanoreceptors (Johnson, 2001) as shown in the Fig.1. These receptors are primarily responsible for tactile perception such as sensing hot, cold, force, pressure, and vibrations. With the process of transduction and encoding this sensory information is turned into an electrical impulse and then sent out to the central nervous system (CNS) for motor response (Hao et al., 2015).
- The sensory ability of human skin is often compromised or impaired due to ageing (Decorps et al., 2014), injury, nerve damage, skin burns, and surgical procedures.
- To revive the sensory ability of skin, a wide variety of novel approaches and materials are reported to fabricate the tactile sensors (Yang et al., 2017). In this poster, the synthesis of nanofibers from Bombyx mori silk cocoons for the development of artificial tactile sensors is presented (Wang et al., 2017).

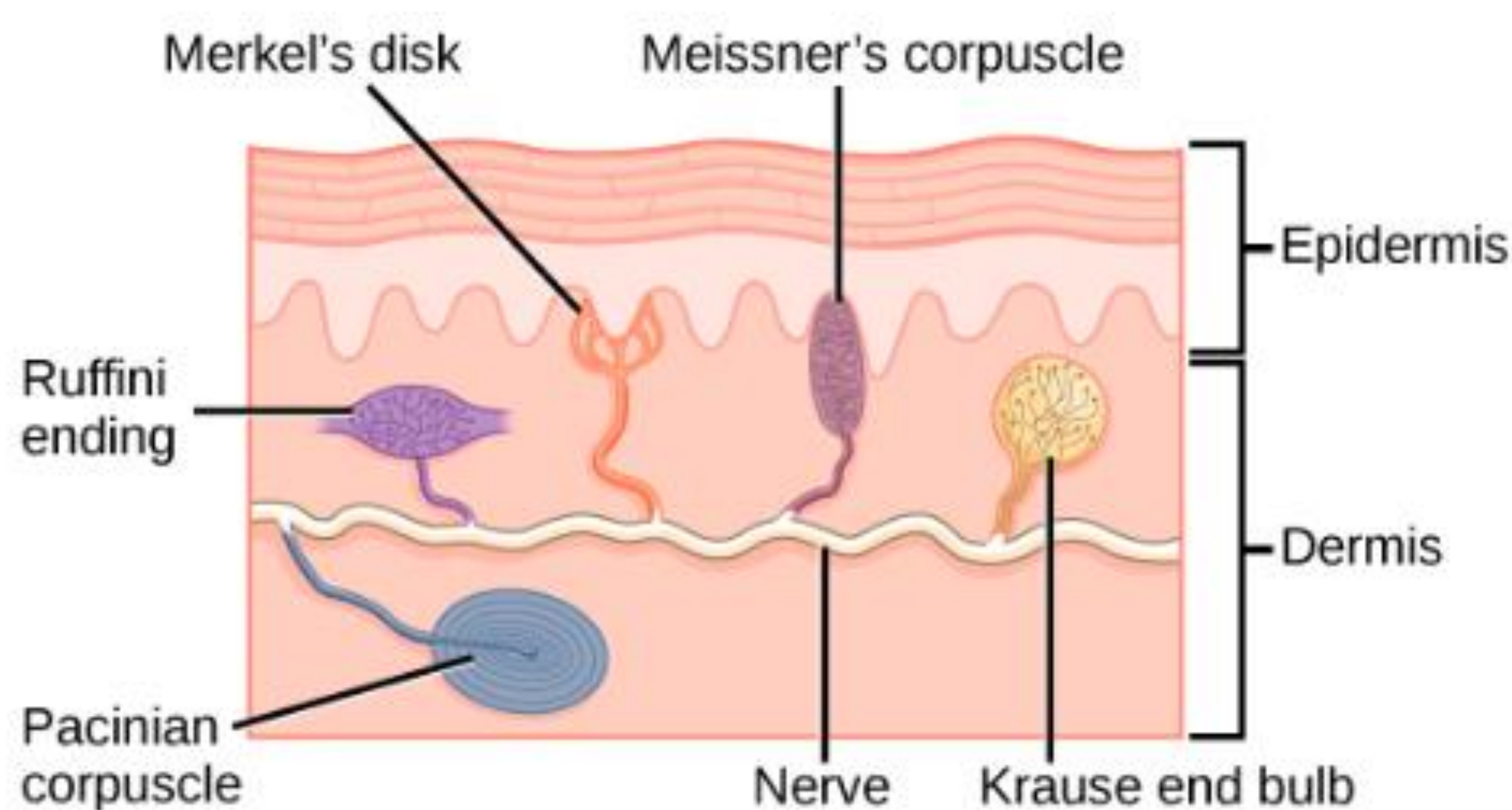


Fig. 1. Primary Mechanoreceptors

(Somatosensation | Boundless Biology, n.d.)

Procedure

Following are the steps involved in the synthesis of nanofibers from the Bombyx mori silk cocoons as show in Fig.2 :

- 1) Extraction of solution from Bombyx mori silk cocoons
- 2) Synthesis of nanofibers from Silk Fibroin (SF) (Protein) solution using electrospinning
- 3) Analysis of developed nanofibers using scanning electron microscope (SEM)

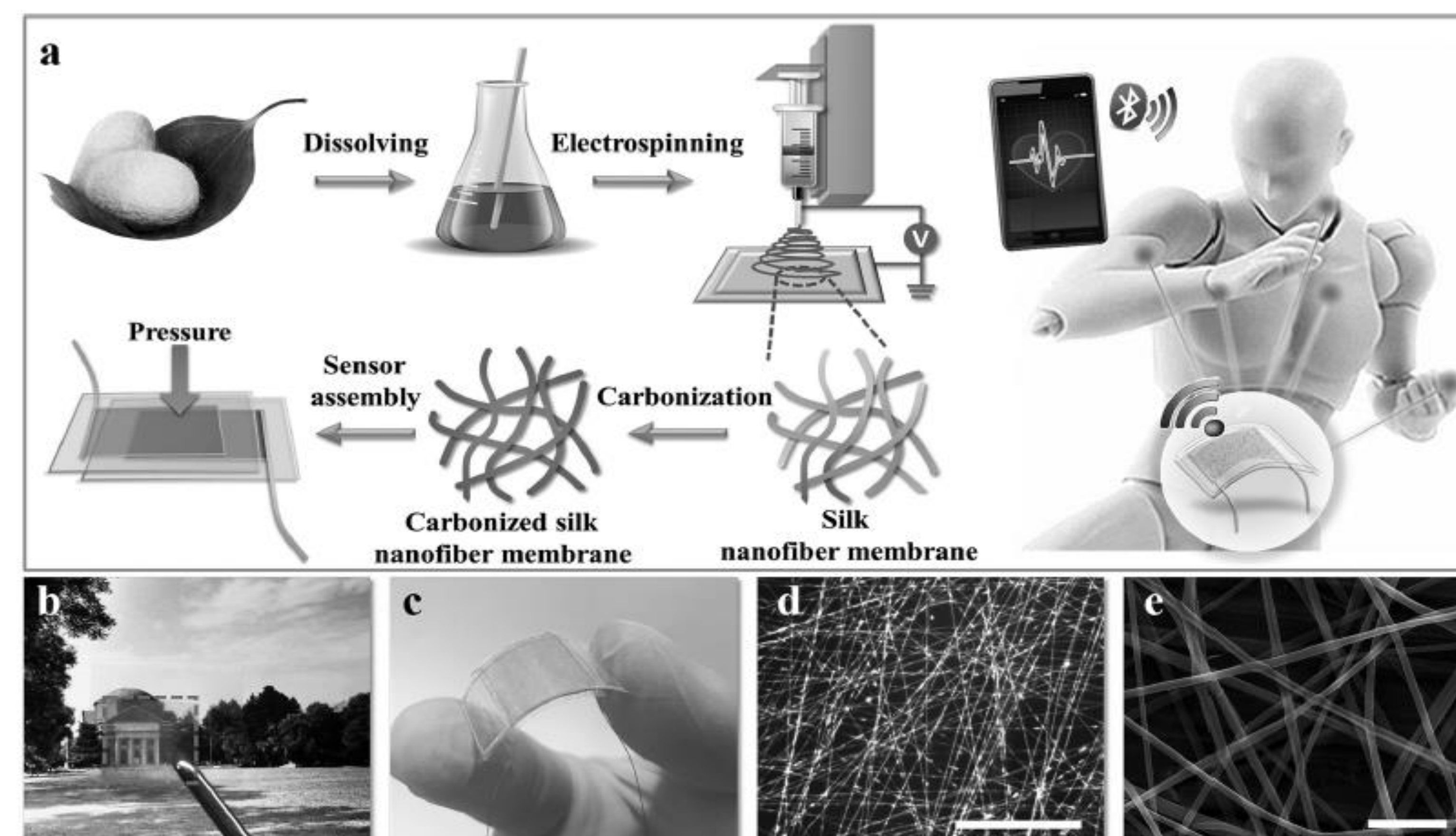


Fig. 2. Synthesis of Nanofibers from the Bombyx mori silk cocoons (Wang et al., 2017)

Results

Table 1 summarizes the results reported of the research carried out by (Wang et al., 2017).

Parameter	Result
Concentration of silk fibroin	8%
Operating voltage of electrospinning machine	20kV
Diameter of the nanofibers	350 nm
Sensitivity	34.47 kPa ⁻¹
Response time	< 16.7 msec
Stability	> 10,000 cycles
Transparency at 800nm UV-Vis spectroscopy	90.75 %

Conclusion

Tactile perception is an essential function of human skin. Without this, it would be impossible to perform routine tasks. Numerous methods are developed to quantify and revive the tactile sensation. Synthesis of nanofibers from the Bombyx mori silk cocoons is only one of these ways. Integration of these fibers underneath the skin is still an exciting avenue to explore.

References

- Decorps, J., Saumet, J. L., Sommer, P., Sigauco-Roussel, D., & Fromy, B. (2014). Effect of ageing on tactile transduction processes. *Ageing Research Reviews*, 13(1), 90–99. <https://doi.org/10.1016/j.arr.2013.12.003>
- Hao, J., Bonnet, C., Amsalem, M., Ruel, J., & Delmas, P. (2015). Transduction and encoding sensory information by skin mechanoreceptors. *Pflügers Archiv European Journal of Physiology*, 467(1), 109–119. <https://doi.org/10.1007/s00424-014-1651-7>
- Johnson, K. O. (2001). The roles and functions of cutaneous mechanoreceptors. *Current Opinion in Neurobiology*, 11(4), 455–461. [https://doi.org/10.1016/S0959-4388\(00\)00234-8](https://doi.org/10.1016/S0959-4388(00)00234-8)
- Rockwood, D. N., Preda, R. C., Yücel, T., Wang, X., Lovett, M. L., & Kaplan, D. L. (2011). Materials fabrication from Bombyx mori silk fibroin. *Nature Protocols*, 6(10), 1612–1631. <https://doi.org/10.1038/nprot.2011.379>
- Somatosensation | Boundless Biology. (n.d.). Retrieved August 10, 2021, from <https://courses.lumenlearning.com/boundless-biology/chapter/somatosensation/>
- Wang, Q., Jian, M., Wang, C., & Zhang, Y. (2017). Carbonized Silk Nanofiber Membrane for Transparent and Sensitive Electronic Skin. *Advanced Functional Materials*, 27(9). <https://doi.org/10.1002/adfm.201605657>
- Yang, T., Xie, D., Li, Z., & Zhu, H. (2017). Recent advances in wearable tactile sensors: Materials, sensing mechanisms, and device performance. *Materials Science and Engineering R: Reports*, 115, 1–37. <https://doi.org/10.1016/j.mser.2017.02.001>