One-Step and Spontaneous In-Situ Growth of Au “Nanopopcorn” on Metallic MoS2 Coated Double-Twisted Fiber for Ultra-Sensitive Textile Pressure Sensor

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Abstract

Highly conductive fibers play an essential role in the development of electronic textiles for wearable devices [1-4]. Even though great progress has been made recently, it still remains big challenges to develop simple and rapid method to prepare fibers with stretchability, high sustainability as well as electrical conductivity. Herein, we proposed a simple, rapid, and scalable approach for the fabrication of stretchable and conductive fiber by decorating Au nanostructures on a double-twisted fiber coated with metallic MoS2 nanosheets (MoS2-coated fiber). The formation of Au nanostructures with a “popcorn”-like shape (namely Au “nanopopcorn”, AuNPC) occurs instantaneously and spontaneously on the surface of MoS2-coated fiber, without any additional reducing agents or heating conditions. The inherent properties such as excellent conductivity, stretchability, and stability enable the AuNPC-MoS2 composite-coated fiber to be an ideal choice for fabricating wearable electronics. Results show that the composite-coated fiber has piezoresistive ability to quantify mechanical deformations such as stretching, bending, and pressure force. The fiber-based pressure sensor shows excellent sensitivity to pressure (0.19 kPa−1), fast response time (93 ms), and excellent durability. The composite-coated fiber can also be integrated into a glove to detect human motion in real time. Furthermore, the conductive AuNPC-MoS2 composite-coated fiber can be weaved into electronic textiles to fabricate an ultra-sensitive pressure sensor with sensing arrays, which has multiple 2D force mapping properties. Therefore, we envision that this simple, rapid, and scalable method to fabricate composite-coated fiber would show great potential in the field of electronic textiles and wearable devices.

***Keywords***:Conductive fiber; Metallic MoS2 nanosheets; Gold nanostructures; Self-growth; Textile pressure sensor; Wearable device.

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| Figure 1: Fabrication processes of the AuNPC-MoS2 composite-coated fiber and its applications. |

References

1. Tran Quang, T.; Lee, N.-E., Recent Progress on Stretchable Electronic Devices with Intrinsically Stretchable Components. Adv. Mater. 2017, 29 (3), 1603167.
2. Son, D.; Lee, J.; Qiao, S.; Ghaffari, R.; Kim, J.; Lee, J. E.; Song, C.; Kim, S. J.; Lee, D. J.; Jun, S. W.; Yang, S.; Park, M.; Shin, J.; Do, K.; Lee, M.; Kang, K.; Hwang, C. S.; Lu, N.; Hyeon, T.; Kim, D.-H., Multifunctional Wearable Devices for Diagnosis and Therapy of Movement Disorders. Nat. Nanotechnol. 2014, 9 (5), 397-404.
3. Cherenack, K.; Zysset, C.; Kinkeldei, T.; Muenzenrieder, N.; Troester, G., Woven Electronic Fibers with Sensing and Display Functions for Smart Textiles. Adv. Mater. 2010, 22 (45), 5178-5182.
4. Yetisen, A. K.; Qu, H.; Manbachi, A.; Butt, H.; Dokmeci, M. R.; Hinestroza, J. P.; Skorobogatiy, M.; Khademhosseini, A.; Yun, S. H., Nanotechnology in Textiles. ACS Nano 2016, 10 (3), 3042-3068.