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Observation of Electrospun Yttrium Cobalt Oxide $YCoO_3$ Nanofibers Calcined at Different Temperatures

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Perovskite oxides, with general formula ABO_3, have attracted great attention in recent years, due to their simplified structure and customizable composition to achieve tunable properties [1-4]. Among the various types of perovskites, yttrium cobaltate ($YCoO_3$) has been synthesized by a traditional sol-gel method [5-9], or a solution combustion synthesis method [10]. This material was used to study gas sensing [6, 8], fuel cells [9] and catalyst [10] applications. In this work, we report a synthesis of $YCoO_3$ by electrospinning followed with calcination at different temperatures.

In a typical synthesis, yttrium nitrate hexahydrate and cobalt nitrate tetrahydrate, in 0.8:1 molar ratio, were dissolved in a 20 mL 50/50 mixed solvent of ethanol and N, N-dimethylformamide (DMF). 2.0 g of polyvinylpyrrolidone was added to the above solution to form an electrospinnable sol-gel. The sol-gel was then electrospun at an applied voltage of 18 kV and a flow rate of 0.5 mL/h, and the spinneret to collector distance was 17 cm. The electrospun sample was calcined at 700–900 °C at a 2 °C/min heating rate to get pure $YCoO_3$. Quantitative measurements were conducted using ImageJ [11].

Fig. 1(a) shows an SEM image of as-spun sample before the calcination. The nanofibers have an almost uniform size distribution. A measurement using ImageJ showed nanofiber diameter of 166 ± 43 nm, with normal or lognormal distribution (Fig. 1b) [12].

The images of samples after calcination are shown in Fig. 2. After calcination at 700 °C, as shown in Fig. 2(a), the diameter is much reduced, because of the removal of organic components. The size measurement is shown in Fig. 2(d), with diameter of 45 ± 12 nm. After calcination at 800 °C (Fig. 2b), the size is measured as 52 ± 13 nm, which is slightly larger than that by the 700 °C calcination (Fig. 2e). However, after a high temperature calcination at 900 °C, the shape has changed to particles, as shown in Fig. 2(c). A quantitative measurement reveals a much-enlarged size, with 317 ± 55 nm that is even larger than that of the original as-spun fiber. This phenomenon implies the melting of the nanoscale particles, or the growth of crystallites by aggregation during the calcination. The calcined materials with different size and morphology provide opportunities to identify the factors dominating their sensing properties [13].

References:

[1] K.D. Pelucarte, et al., Mater. Adv. **3** (2022**)**, 2096-2103. DOI: 10.1039/D1MA00984B
[2] G. George, et al., *Ceram. Inter*. **44** (2018), 21982-21992. DOI: 10.1016/j.ceramint.2018.08.313
[3] S.R. Ede, et al., *ACS Catal.* **11** (2021), 4327-4337. DOI: 10.1021/acscatal.1c00465
[4] S.R. Ede, et al., J. Mater. Chem. **A9** (2021) 20131-20163. DOI: 10.1039/D1TA04032D
[5] O.S. Buassi-Monroy, et al., Mater. Lett. 58 (2004), 716-718. DOI: 10.1016/j.matlet.2003.07.001
[6] A. Fort, et al., AIP Conf. Pro.**1362** (2011), 55-57. DOI: 10.1063/1.3626304

[7] Y. Wei, et el., AIP Adv. **4** (2014), 127134. DOI: 10.1063/1.4904811
[8] T. Addabbo, et al., Sens. Actuators **B221** (2015), 1137-1155. DOI: 10.1016/j.snb.2015.07.079
[9] T. Sakai, et al., J. Mater. Chem. **A9** (2021), 3584-3588. DOI: 10.1039/D0TA09487K
[10] S. Dimitrovska-Lazova, et al., J. Solid State Electrochem. **16** (2012), 219–225. DOI: https://doi.org/10.1007/s10008-011-1320-0.
[11] M.D. Abramoff, et al., Biophotonics Inter. **11** (2004), 36-42.
[12] Z.P. Luo. J. Mater. Sci. **45** (2010), 3228-3241. DOI: 10.1007/s10853-010-4330-x
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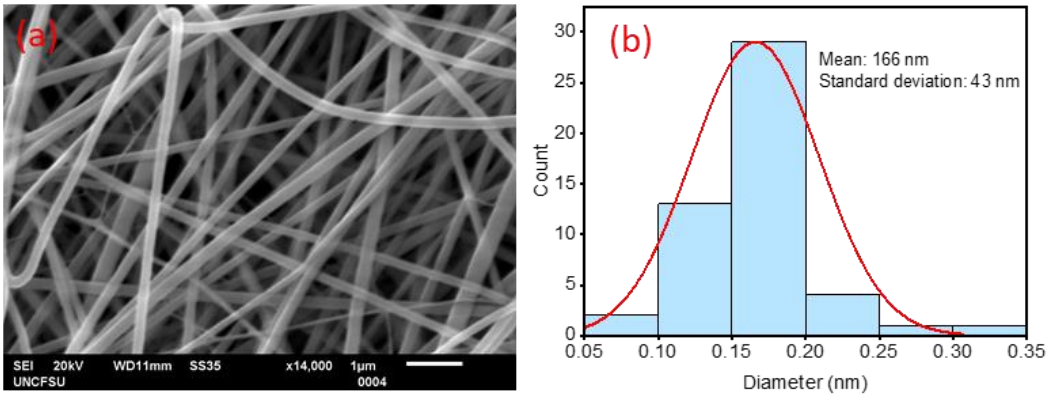

Figure 1. SEM image of electrospun nanofibers before calcination (a), and the nanofiber diameter distribution (b).

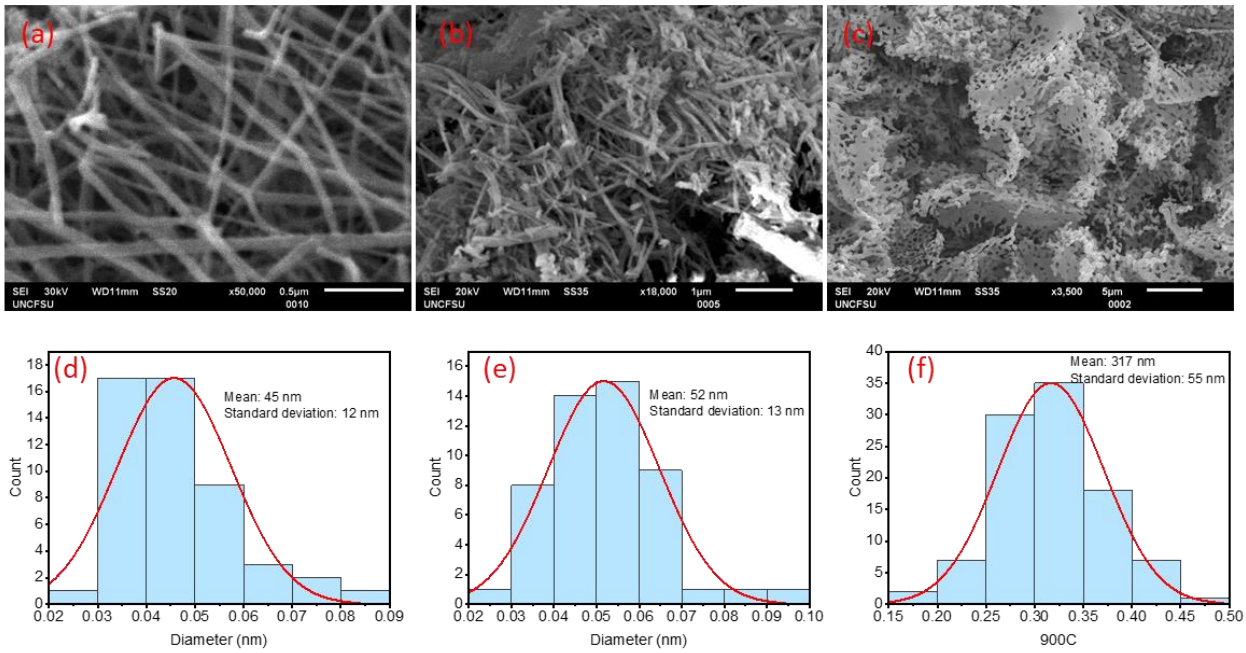

Figure 2. SEM images of samples calcined at 700 °C (a), 800 °C (b), and 900 °C (c), and their diameter distributions below each image (d–f).

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