Electronic Supplementary Material (ESI) for RSC Advances.

Hydrothermal synthesis of cotton-based $BiVO_4$/Ag composite for photocatalytic degradation of C.I. Reactive Black 5

Jiangang Qu[a,&], *Jiaqi Qian*[a,&], *Mengtao Wu*[a], *Qinghui Mao*[a*], *Min Li*[b**]

[a] School of Textile and Clothing, Nantong University, Nantong, Jiangsu 226019, China

[b] Key Laboratory of Eco-textiles, Ministry of Education, Jiangnan University, Wuxi, Jiangsu, 224122, China

[*]Corresponding authors:

1731mqh@ntu.edu.cn (Qinghui Mao);

minmin0421@163.com (Min Li)

1. Electrical conductivity and antibacterial property of composite materials

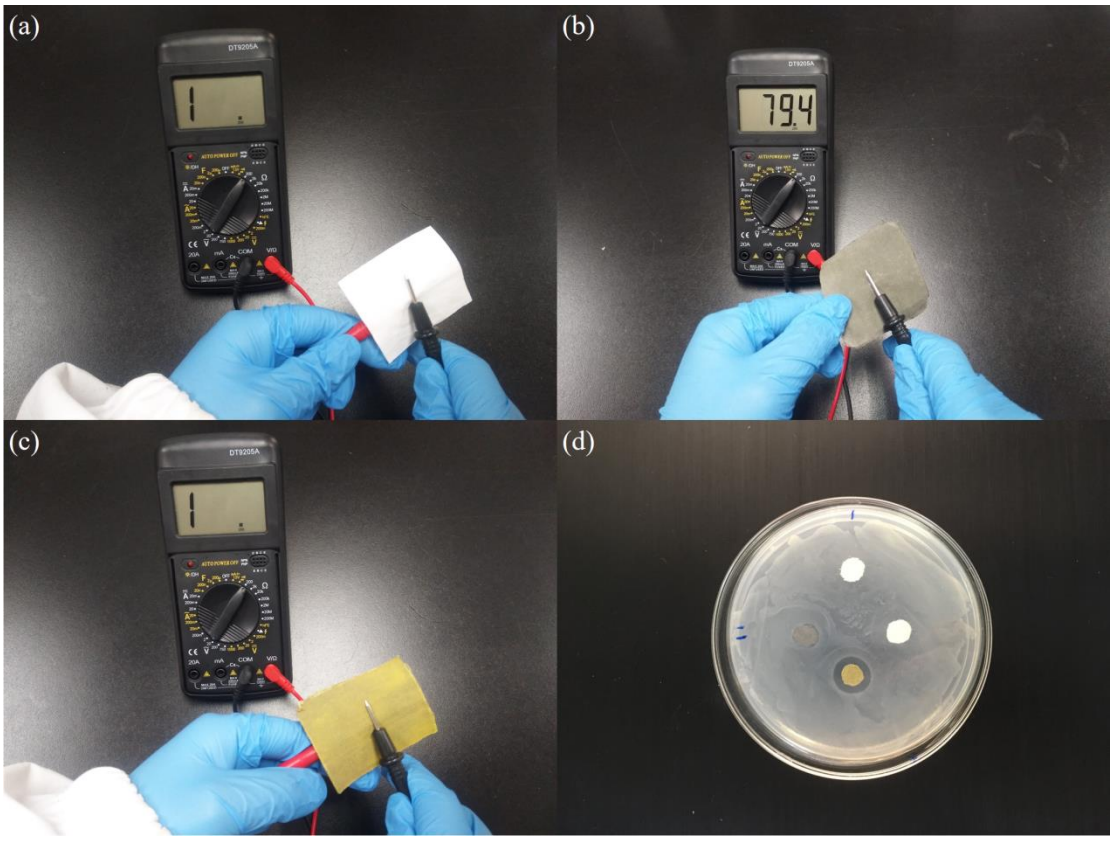

Fig. S1. (a-c) Electrical conductivity of Cotton-K, Ag/Cotton-K and $BiVO_4$/Ag/Cotton-K. (d) antibacterial property of Cotton, Cotton-K, Ag/Cotton-K and $BiVO_4$/Ag/Cotton-K.

The results of electrical conductivity of composites are shown in Fig. S1a-c. Obviously, Cotton-K and $BiVO_4$/Ag/Cotton-K have no electrical conductivity, while Ag/Cotton-K has a certain electrical conductivity. The reason why $BiVO_4$/Ag/Cotton-K has no electrical conductivity is that much $BiVO_4$ particles grow on Ag/Cotton-K and cover Ag, thus losing its electrical conductivity.

The antibacterial properties of the composite materials are shown in Fig. 1d. It can be seen from the figure that Cotton and Cotton-K have no antibacterial properties, Ag/Cotton-K and $BiVO_4$/Ag/Cotton-K have certain antibacterial property, while $BiVO_4$/Ag/Cotton-K has the largest antibacterial circle.

2. Structural formula of RB5

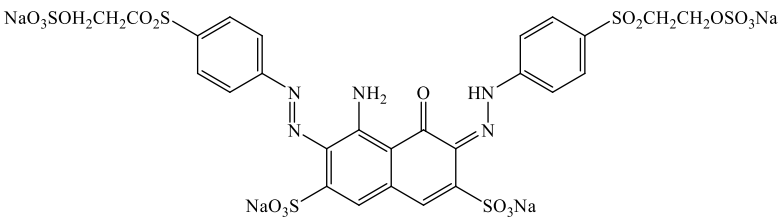

Fig. S2. Structural formula of RB5.

3. Effects of preparation pH value and temperature on photodegradation efficiency

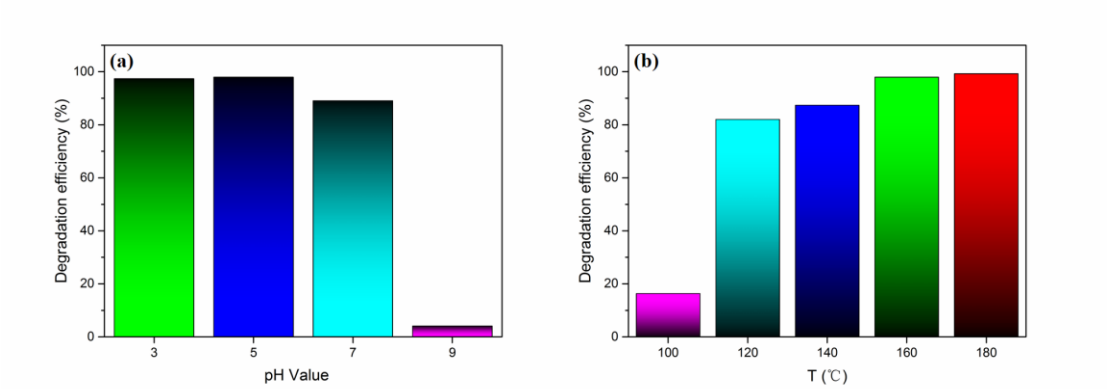

Fig. S3. Photodegradation efficiency of KN-B5 by $BiVO_4$/Ag/Cotton-K synthesized at different (a) pH values and (b) temperatures.

The results of degradation efficiency of RB5 by $BiVO_4$/Ag/Cotton-K synthesized at different pH values under xenon light irradiation are shown in Fig. S3a. It can be seen from the Fig. S3a that after 90 min of xenon light irradiation, with the increase of pH value, the degradation efficiency becomes lower. The results show that $BiVO_4$ synthesized in acidic condition has good photocatalytic activity, but the strength of cotton fabric is damaged when the pH value is 3. When the pH value is 3 or 5, the composites have high photocatalytic activity. Therefore, pH value of 5 is selected as the best condition.

The results of degradation efficiency of RB5 by $BiVO_4$/Ag/Cotton-K synthesized at different temperatures under xenon light irradiation are shown in Fig. S3b. When the reaction temperatures are 100 ℃, 120 ℃, 140 ℃, 160 ℃, 180 ℃, the degradation efficiencies are 16%, 82%, 87%, 99%, 99%, respectively. When the temperature is higher, it has obvious catalytic advantage. But when the temperature is too high, the strength of the fabric will be damaged and even broken. Therefore, to ensure the fabric strength and catalytic activity, 160 ℃ is the optimal reaction temperature.

4. The FTIR spectra of composite materials

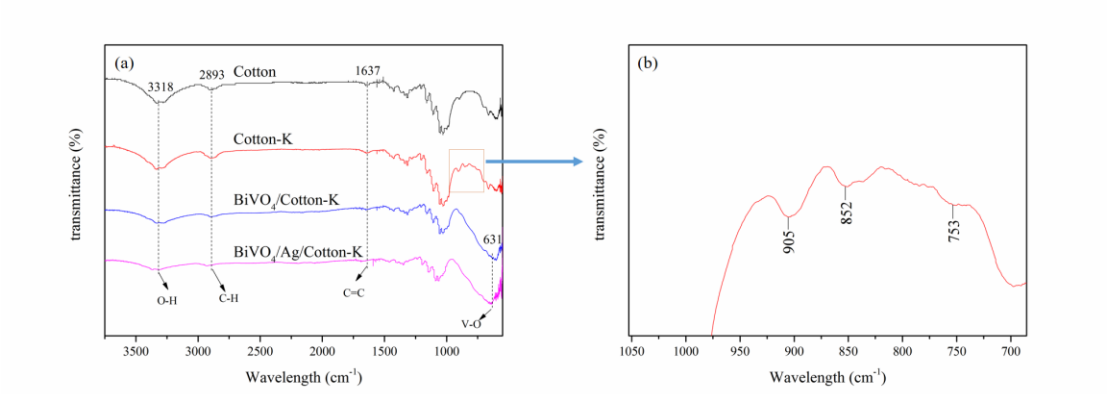

Fig. S4. (a) The FTIR spectra of Cotton, Cotton-K, $BiVO_4$/Cotton-K and $BiVO_4$/Ag/Cotton-K composite materials. (b) Partial enlarged drawing of Cotton-K.

The chemical structure of Cotton, Cotton-K, $BiVO_4$/Cotton-K and $BiVO_4$/Ag/Cotton-K were characterized by Fourier-transform infrared spectroscopy (FTIR) spectra, and the results are shown in Fig. S4. In Fig.S4, the peak at 3318 cm^{-1}, 2893 cm^{-1} and 1637 cm^{-1} are assigned to the vibrations of O-H, C-H and C=C of cotton[1]. The Cotton-K showes extra peaks at 905 cm^{-1}, 852 cm^{-1} and 753 cm^{-1}, correspond to the epoxy group, Si-OH and Si-O-C_2H_5 of KH-560, respectively. The $BiVO_4$/Cotton-K and $BiVO_4$/Ag/Cotton-K have the new peak at 631 cm^{-1} which is assigned to the stretching vibrations of V-O bonds [2]. Above results indicate the well interaction of KH-560, cotton and $BiVO_4$.

5. SEM images of $BiVO_4$/Ag/Cotton-K

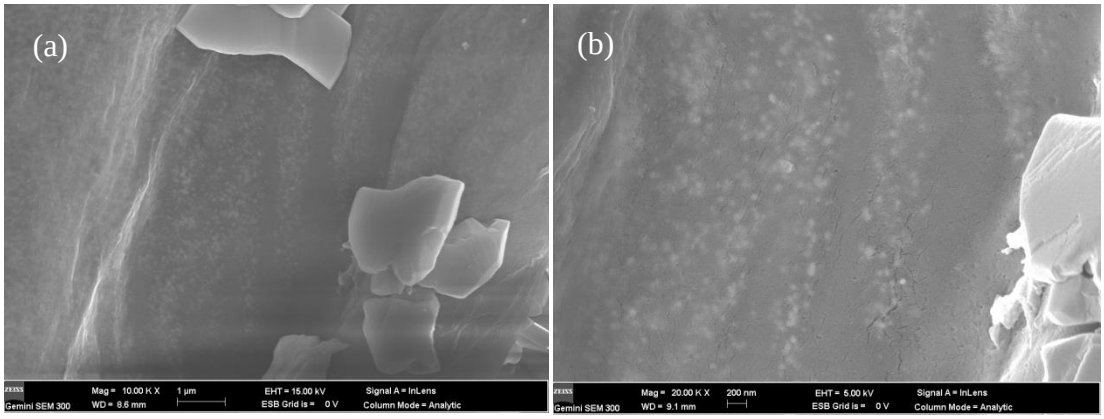

Fig. S5. SEM iamges of $BiVO_4$/Ag/Cotton-K with different magnifications: (a) 10 K, (b) 20 K.

6. Comparison of fabric strength

Tab. S1. Warp and weft yarn strength of $BiVO_4$/Ag/Cotton and $BiVO_4$/Ag/Cotton-K before and after recycling five times.

Sample	$BiVO_4$/Ag/Cotton		$BiVO_4$/Ag/Cotton-K	
	Warp	Weft	Warp	Weft
Strength before recycling/N	3.57	3.42	3.85	3.45
Strength after recycling /N	3.36	3.19	3.89	3.32
Strength change rate/%	5.88	6.73	-1.04	3.77

It can be seen from Tab. S1 that after five times of degradation, the strength of the fiber has a certain decline but all less than 7%, which indicates that cotton itself hardly degrade. The strength of $BiVO_4$/Ag/Cotton-K decreases by no more than 4%, which is significantly less than that of $BiVO_4$/Ag/Cotton-K, indicating that the addition of silane coupling agent KH-560 is beneficial to increase the strength of fabric.

7. References

[1] H. S. Zhang, Recyclable and highly efficient photocatalytic fabric of Fe(III) @ $BiVO_4$/cotton via thiol-ene click reaction with visible-light response in water, Adv Powder Technol (2019) 3182-3192. https://doi.org/10.1016/j.apt.2019.09.027.

[2] Y. L. Wang, K. Ding, R. Xu, D. Yu, W. Wang, P. Gao, B. J. Liu, Fabrication of $BiVO_4$/$BiPO_4$/GO composite photocatalytic material for the visible light-driven

degradation, J. Clean. Prod. 247 (2020) 1-12. https://doi.org/10.1016/j.jclepro.2019.119108.