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Comment

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Comment on "High-Active Anatase TiO_2 Nanosheets Exposed with 95% {100} Facets Toward Efficient H_2 Evolution and CO_2 Photoreduction"

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INTRODUCTION

Since Yang reported anatase TiO_2 with dominant exposed higher surface energy {001} facet,[1] the facet effect of anatase TiO_2 on photocatalysis has been researched intensely.[2−4] In the past three years, {100} facet as another low-index higher surface energy facet with 100% Ti5c atoms also has been researched more and more.[5−7] In a recent study, anatase TiO_2 ultrathin nanosheets with 95% of exposed {100} facet have been prepared via a facile and effective method.[8] Comparing with reported TiO_2 cuboids ($T_{Cuboids}$) with exposed {100} facets, the authors proved that TiO_2 nanosheets (T_{Sheets}) can expose more {100} facets and display higher photocatalytic activity for H_2 evolution and CO_2 photoreduction. But, by analyzing the high-resolution transmission electron microscope (HRTEM) image and SAED images myself, I think that the SAED pattern can not prove their conclusion: the exposed facet of T_{Sheets} was {100} facet.

DISCUSSION

SAED pattern, HRTEM image, and FFT pattern are the most important data to analyze the exposed facets of crystal materials. In the process of TEM and HRTEM, there are many different two-dimensional pictures with different view directions. For example, the TEM images of TiO_2 nano-bipyramids with dominant exposed {101} facets may be rhomboid with [010] or [111] zone; the TEM images of TiO_2 nanorods with dominant exposed {010} facets may be elongated rhombic with [010] zone or square with [001] zone; and the TEM images of TiO_2 nanosheets with dominant exposed {001} facets may be square with [001] zone or elongated rhombic with [010] zone. So, HRTEM image with only one direction is not persuasive to confirm its exposed facets. For nanosheets, HRTEM with top view and side view are very important. But in Xu's paper, only the top-view HRTEM image (Figure 2c) was displayed. It can be seen that the distance of the visible lattice fringes was measured to be 0.378 nm, which is in agreement with the lattice spacing of (010) atomic plane of anatase TiO_2. But the annotation of SAED pattern was incorrect. As we known that the lattice spacing of (020) and (002) were 0.19 nm and 0.48 nm, respectively.[6,9] So, in the SAED image (Figure 1), the d1/d2 should be 0.40 (0.19/0.48 = 0.40). However, by measuring with Core DRAW X3 software, the actual value is 1.00 (68.58/68.50 = 1.00). And it can be found that the SAED image with [100] orientation was different with reported result in Figure 3a and Figure 3d of ref 9. So, I think that the exposed facets of T_{Sheets} may be not {100} facet. Furthermore, if the published HRTEM and SAED are right, the exposed facets may be {001} facets.

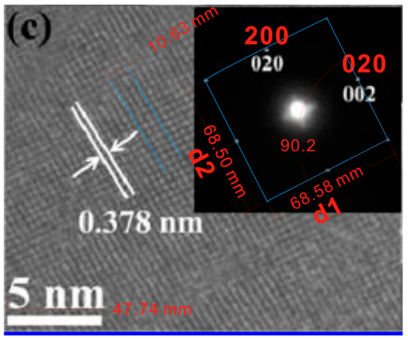

Figure 1. Annotation and measure of Figure 2c of ref 8 using CoreDRAW X3 software.

And the possible right annotations are shown in Figure 1. To confirm the dominant exposed facets of T_{Sheets}, the HRTEM image and SAED pattern should be retested, and more HRTEM images and FFT pattern with different zones, especially side view, should be given.

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Notes

The authors declare no competing financial interest.

REFERENCES

(1) Yang, H. G.; Sun, C. H.; Qiao, S. Z.; Zou, J.; Liu, G.; Smith, S. C.; Cheng, H. M.; Lu, G. Q. *Nature* **2008**, *453*, 638−641.

(2) Yang, H. G.; Liu, G.; Qiao, S. Z.; Sun, C. H.; Jin, Y. G.; Smith, S. C.; Zou, J.; Cheng, H. M.; Lu, G. Q. *J. Am. Chem. Soc.* **2009**, *131*, 4078−4083.

(3) Han, X.; Kuang, Q.; Jin, M.; Xie, Z.; Zheng, L. *J. Am. Chem. Soc.* **2009**, *131*, 3152−3153.

(4) Gordon, T. R.; Cargnello, M.; Paik, T.; Mangolini, F.; Weber, R. T.; Fornasiero, P.; Murray, C. B. *J. Am. Chem. Soc.* **2012**, *134*, 6751−6761.

(5) Pan, J.; Liu, G.; Lu, G. Q.; Cheng, H. M. *Angew. Chem., Int. Ed.* **2011**, *50*, 2133−2137.

(6) Zhao, X.; Jin, W.; Cai, J.; Ye, J.; Li, Z.; Ma, Y.; Xie, J.; Qi, L. *Adv. Funct. Mater.* **2011**, *21*, 3554−3563.

(7) Pan, J.; Wu, X.; Wang, L.; Liu, G.; Lu, G. Q.; Cheng, H. M. *Chem. Commun.* **2011**, *47*, 8361−8363.

(8) Xu, H.; Ouyang, S.; Li, P.; Kako, T.; Ye, J. *ACS Appl. Mater. Interfaces* **2013**, *5*, 1348−1354.

(9) Li, J.; Xu, D. *Chem. Commun.* **2010**, *46*, 2301−2303.

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