Supporting information
Solution-Phase Synthesis of Single-Crystalline $Bi_{12}TiO_{20}$ Nanowires with Photocatalytic Properties

Jungang Hou,[ab] Yuanfang Qu,[b] Dalibor Krsmanovic,[a] Caterina Ducati,[a] Dominik Eder,[*a]

R. V. Kumar[*a]

[a]*Department of Materials Science and Metallurgy, University of Cambridge, Cambridge, New Museums Site, Pembroke Street, CB2 3QZ, United Kingdom. Tel.: + 44 1223 334327; Fax: +44 1223 334467; E-mail: rkv10@cam.ac.uk, de235@cam.ac.uk*

[b]*Key Laboratory for Advanced Ceramic and Machining Technology of Ministry of Education, Tianjin University, Tianjin, 300072, China.*

1. Experimental section.

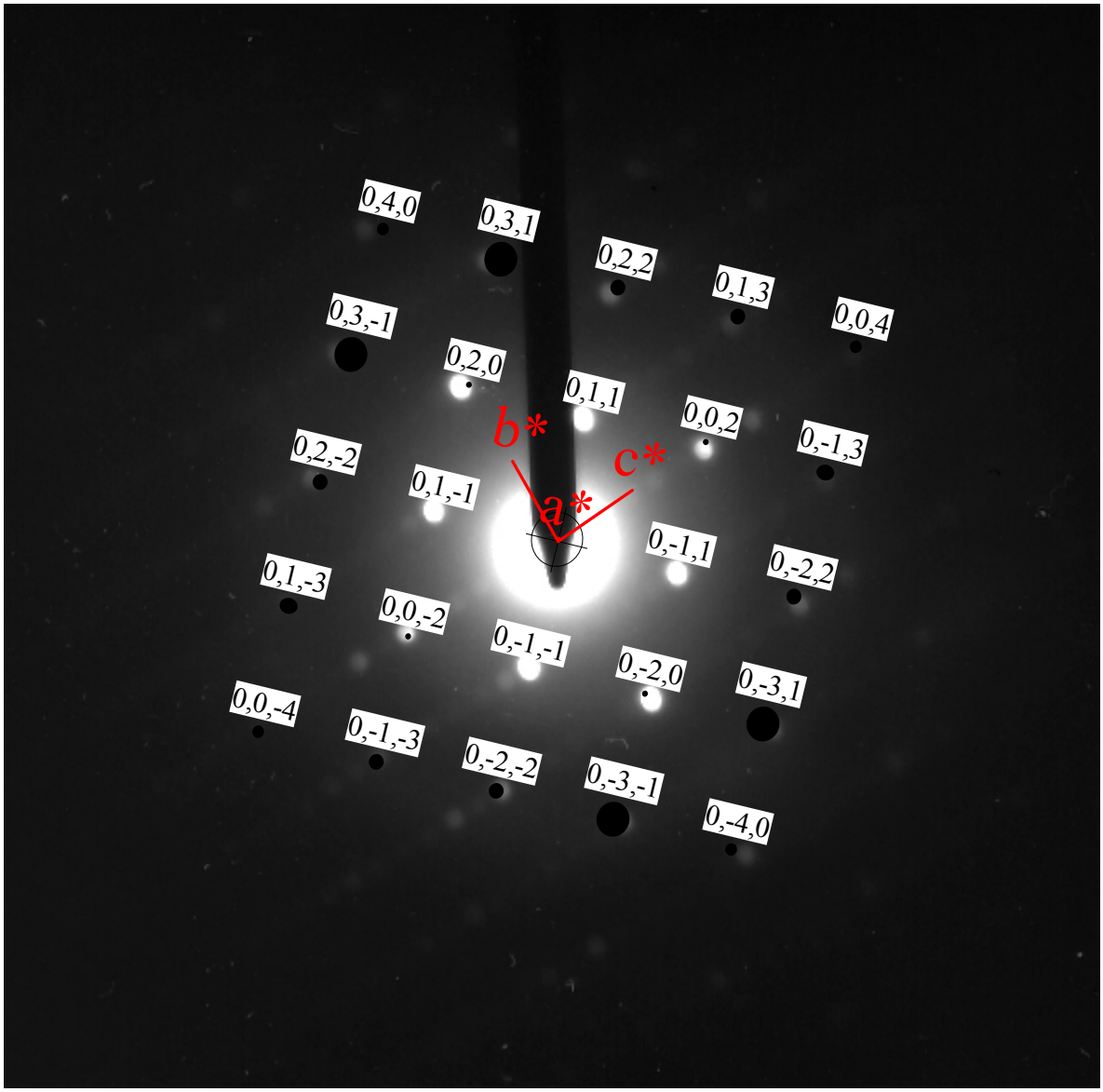
A solution-phase synthesized route to single-crystalline $Bi_{12}TiO_{20}$ NWs was described below. Bismuth nitrate and titanium isopropoxide were used as starting materials with the mole ratio of bismuth : titanium = 12 : 1. 1.03 g $Bi(NO_3)_3{\cdot}5H_2O$, 0.05 g $Ti(OC_3H_7)_4$ was dissolved in 10 mL of deionized water under vigorous stirring. The pH value of the alkali solution was adjusted to 14 using potassium hydroxide, which also served as a mineraliser, followed by adding 0.5 g poly(vinylalcohol) (PVA) as a surfactant. Before being transferred to a 23 mL Teflon-lined autoclave, the solution mixture was prepared under an ultrasonic water bath for 30 min and kept at a filling ratio of 80 % (v/v). The hydrothermal synthesis was conducted at 180 °C for 20 h in an electric oven. After the reaction, crystalline $Bi_{12}TiO_{20}$ was harvested by centrifugation and thorough washings with deionized water. In order to compare the photocatalytic properties of the $Bi_{12}TiO_{20}$ nanowires with bulk $Bi_{12}TiO_{20}$ particles, the bulk $Bi_{12}TiO_{20}$ particles were also produced via a solid-state reaction and calcined at 600 °C for 2 hours.

2. Characterization.

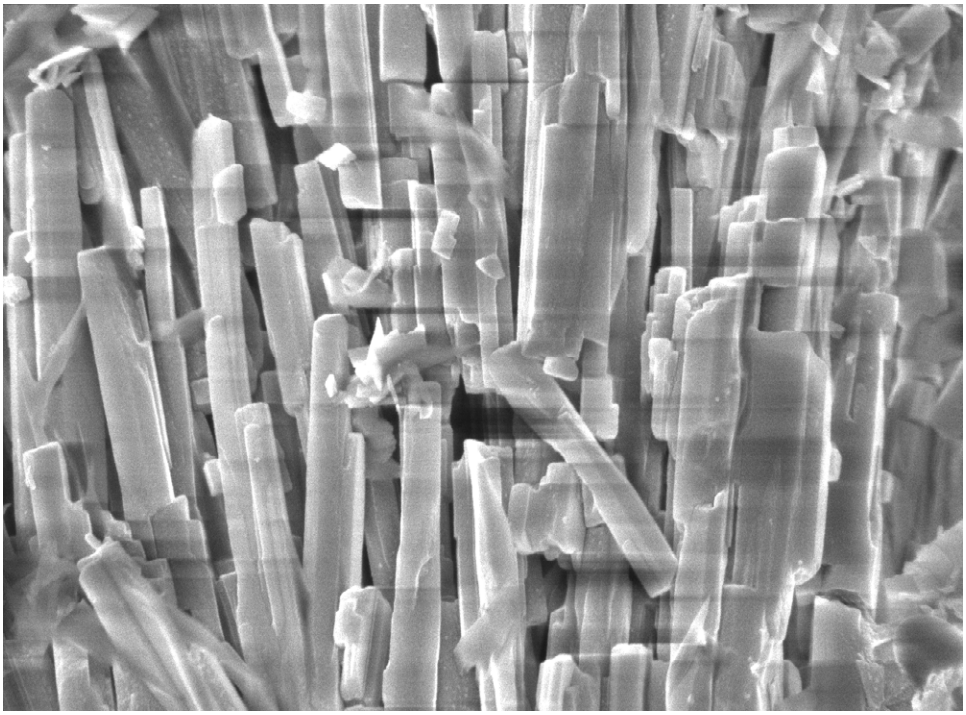
The obtained nanowires were characterized with field emission scanning electron microscopy (FESEM, JEOL, JSM-6340F), X-ray diffraction (XRD) with Cu K_a radiation (λ = 1.5406 Å) operated at a current of 40 kV and a votage of 40 mA, transmission electron microscopy, selected area electron diffraction(TEM/SAED,

CM30) operated at an accelerating voltage of 200 kV. The high resolution TEM image was acquired using a JEOL 4000EX microscopy, operated at 400kV. The surface area of the $Bi_{12}TiO_{20}$ nanowires and bulk $Bi_{12}TiO_{20}$ particles were measured by TriStar 3000-BET/BJH Surface Area. In addition, the photocatalytic properties of samples for the $Bi_{12}TiO_{20}$ nanowires, bulk $Bi_{12}TiO_{20}$ particles and methyl orange without any nanowires and particles under UV-light irradiation were measured. 150 mg of each sample was put in a quartz beaker and, with the aid of ultrasonication, dispersed in 100 ml of deionised water containing methyl orange (0.005 M). After 20 min of stirring, the suspension was illuminated with UV light (254 nm, 6 W). In 10 min intervals, 0.5 ml of the suspension was taken, centrifuged and analysed by UV-vis spectroscopy (Perkin Elmer Lambda 850).

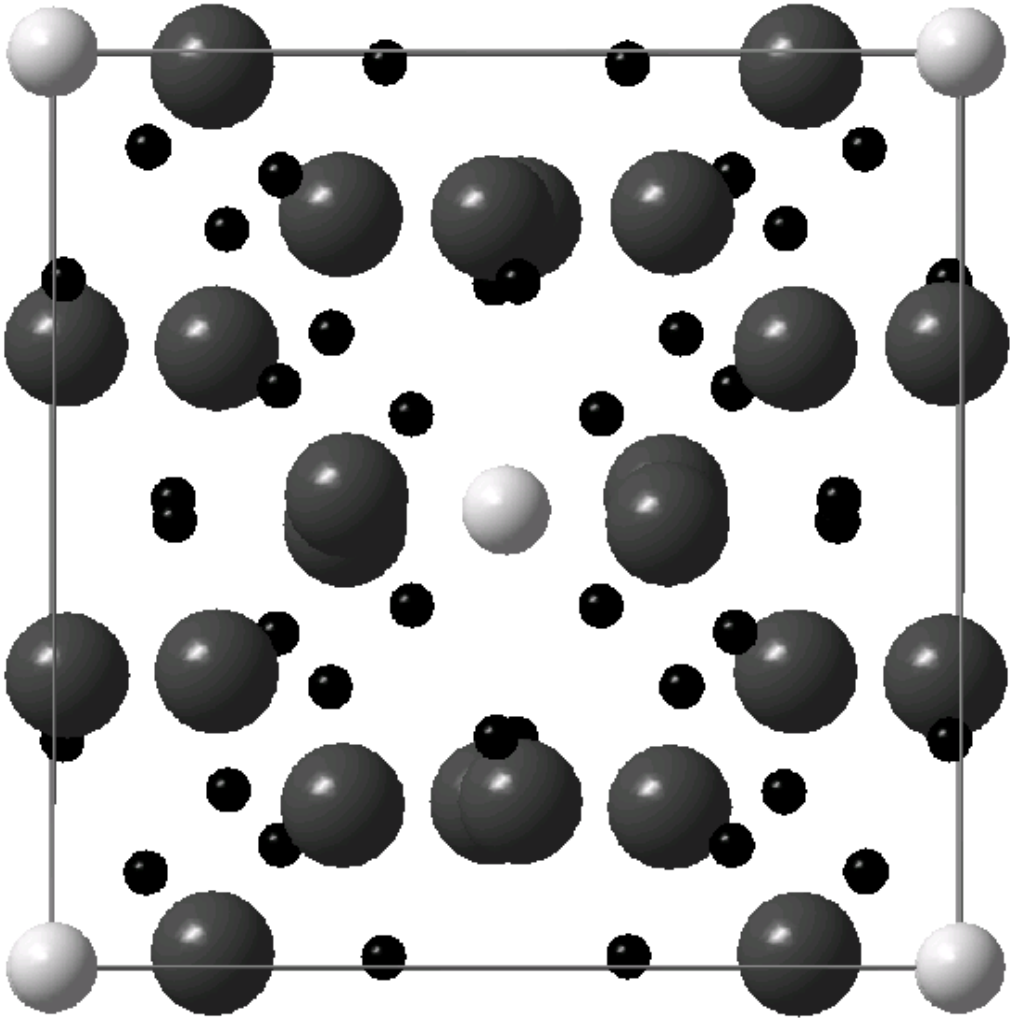
3. SAED pattern of the $Bi_{12}TiO_{20}$ nanowire in (a).



4. At the higher pH of 14, in the absence of PVA, the morphology can be described as non-uniform nanorods and some nanoplates.



5. The ball-and-stick computer model for the $Bi_{12}TiO_{20}$ might help visualizing the structure. Ti atoms are in light grey, Bi atoms in medium grey, O atoms in black (small spheres).



Reference:

a) W. Wei, Y. Dai, B. B. Huang, *J. Phys. Chem. C*, 2009, **113**, 5658.