**Support Information**

**Synthesis** **of crystal-phase and color tunable mixed anion co-doped titanium oxides and their controllable photocatalytic activity**

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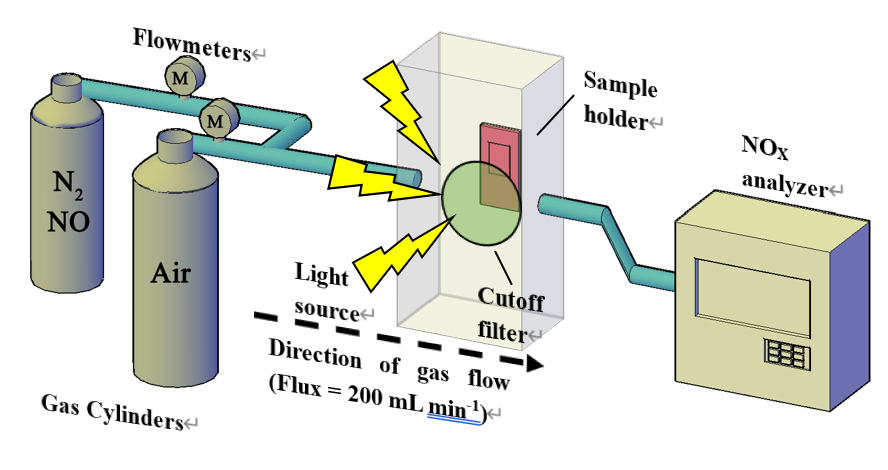
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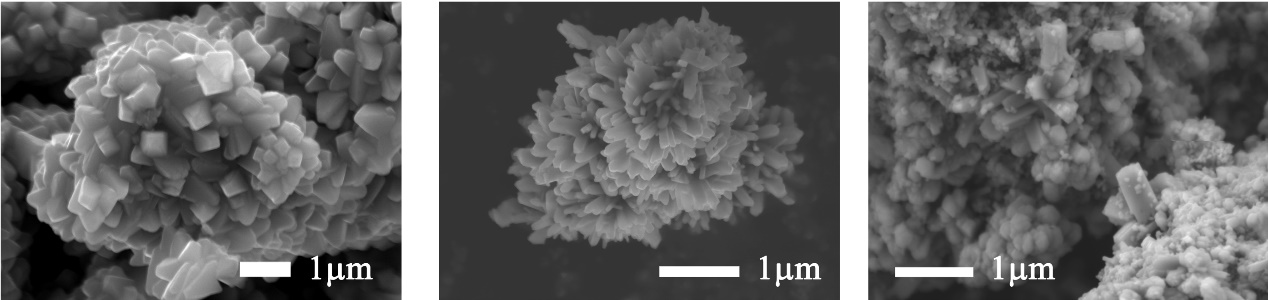
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Scheme S1. Synthesis flow chart for B and N co-doped TiO2.



**Scheme S2.** The schematic light-driven NO decomposition system.



1. **(b) (c)**

**Fig. S1.** SEM images of the as-prepared(a) BN-Ana, (b) BN-Rut, (c) BN-Broparticles.

Table S1. Color parameters of samples with different nitridation time at 600oC in terms of CIELAB system

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Phase | Nitridation time / min | Sample name | L\* | a\* | b\* | h˚ | C |
| Anatase | 30 | BNA\_30 | 39.15 | 10.01 | 6.29 | 32 | 12 |
| 60 | BNA \_60 | 39.61 | 9.01 | 6.17 | 34 | 11 |
| 120 | BNA \_120 | 37.36 | 7.75 | 4.51 | 30 | 9 |
| Rutile | 30 | BNR\_30 | 53.44 | -4.12 | 4.03 | 316 | 6 |
| 60 | BNR \_60 | 60.52 | -3.83 | 4.54 | 310 | 6 |
| 120 | BNR \_120 | 47.70 | -3.32 | 2.69 | 321 | 4 |
| Brookite | 30 | BNB \_30 | 56.63 | -3.28 | 7.12 | 295 | 8 |
| 60 | BNB \_60 | 60.41 | -2.92 | 6.61 | 294 | 7 |
| 120 | BNB \_120 | 54.60 | -3.35 | 6.99 | 296 | 8 |

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**Fig. S2.** The dynamic changes in L\* a\* b\* parameters were drawn as the function of nitridation time.

Table S2. Color parameters of pre-oxidized samples with different nitridation time at 600oC in terms of CIE L\*a\*b\* coordinate

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Phase | Nitridation time / h | Sample name | L\* | a\* | b\* | h˚ | C |
| Anatase | 1 | BNAO\_1 | 76.05 | 4.45 | 17.40 | 76 | 18 |
| 2 | BNAO\_2 | 59.08 | 11.59 | 16.62 | 55 | 20 |
| 3 | BNAO\_3 | 39.20 | 6.52 | 4.48 | 34 | 8 |
| Rutile | 1 | BNRO\_1 | 62.30 | -3.35 | 1.86 | 331 | 4 |
| 2 | BNRO\_2 | 59.30 | -4.61 | 4.14 | 318 | 6 |
| 3 | BNRO\_3 | 52.25 | -4.26 | 3.07 | 324 | 5 |
| Brookite | 1 | BNBO\_1 | 81.21 | -1.91 | 6.51 | 286 | 7 |
| 2 | BNBO\_2 | 76.30 | -2.46 | 6.20 | 292 | 7 |
| 3 | BNBO\_3 | 69.93 | -3.94 | 8.02 | 296 | 9 |

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**Fig. S3.** Variations of L\* a\* b\* parameters of pre-oxidated samples as the function of nitridation time.

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**Fig. S4.** The deNO*x* capacity of pre-oxidated B and N co-doped TiO2 prepared by different nitridation time (1, 2, and 3 h). The columns are grouped by crystal phases. Red is for anatase, blue is for rutile and green is for brookite. Three kinds of irradiation lights (λ > 510, 400, and 290 nm) are utilized to investigate the specific photocatalytic activity under different light wavelengths.

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**Fig. S5.** The NO photodegradation capacity under λ > 510 nm, λ > 400 nm, and λ > 290m nm light irradiation for (a) various photocatalysts, together with Degussa P25 as a reference and (b) The results of five times cycling experiments under successive visible light irradiation (λ ≥ 400 nm). N is cycling times.

**Table S3**. Comparisons of different photocatalysts for photocatalytic

NOremoval under visible light irradiation (*λ* ˃ 400 nm)

|  |  |  |
| --- | --- | --- |
| Photocatalyst | Activity (%) | Reference |
| GaON | 10 | [S-[1](#_ENREF_1)] |
| GaN:ZnO  BiVO4 | 12  15 | [S-[2](#_ENREF_2)]  [S-[3](#_ENREF_3)] |
| Ca-siloxene | 20 | [S-[4](#_ENREF_4)] |
| P25 (TiO2) | 20.9 |  |
| C-TiO2 | 29 | [S-[5](#_ENREF_5), S-[6](#_ENREF_6)] |
| N-TiO2 | 30 | [S-[6](#_ENREF_6), S-[7](#_ENREF_7)] |
| BiOX (X = Cl, Br, I) | 25, 30, 2 | [S-[6](#_ENREF_6)] |
| NaTaO3 | 30 | [S-[8](#_ENREF_8)] |
| Bi2WO6  (Zn1+*x*Ge) (N2Ox) | 30  35 | [S-[3](#_ENREF_3)]  [S-[9](#_ENREF_9)] |
| OVs-TiO2 | 45 | [S-10] |
| BN-Ana  BN-Rut  BN-Bro | 0.4  3.7  32 | This work  This work  This work |

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