Electronic Supplementary Material (ESI) for Catalysis Science & Technology.

Cocatalyst engineering to weaken the charge screening effect over Au-$Bi_4Ti_3O_{12}$ for piezocatalytic pure water splitting

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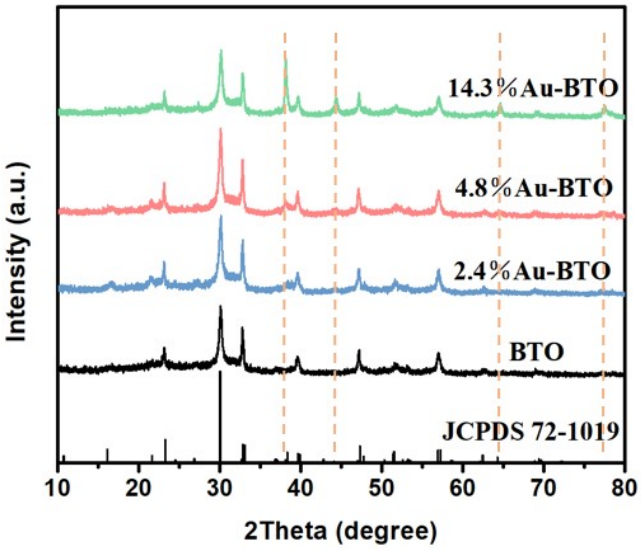

Fig. S1 XRD patterns of BTO, 2.4% Au-BTO, 4.8% Au-BTO and 14.3% Au-BTO.

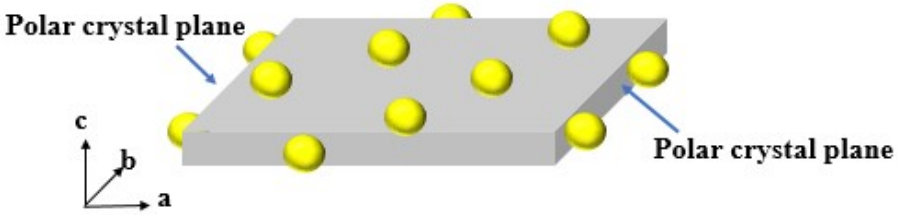

Fig. S2 The schematic diagram of polar crystal planes and non-polar crystal planes.

The spontaneous polarization and piezoelectric response of BTO are along a-axis of the orthorhombic structure [1]. Besides, as shown in Fig. S2, the crystal planes perpendicular to the spontaneous polarization are polar crystal planes, and other crystal planes are non-polar crystal planes.

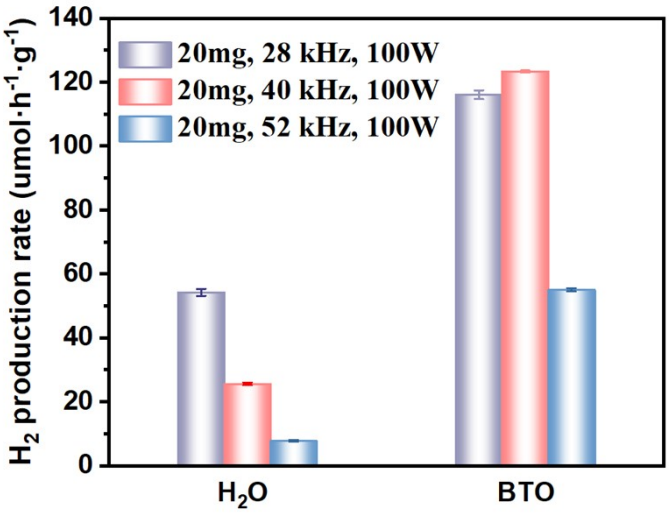

Fig. S3 The H_2 production rate under ultrasonic vibration of 100 W with different frequency over BTO.

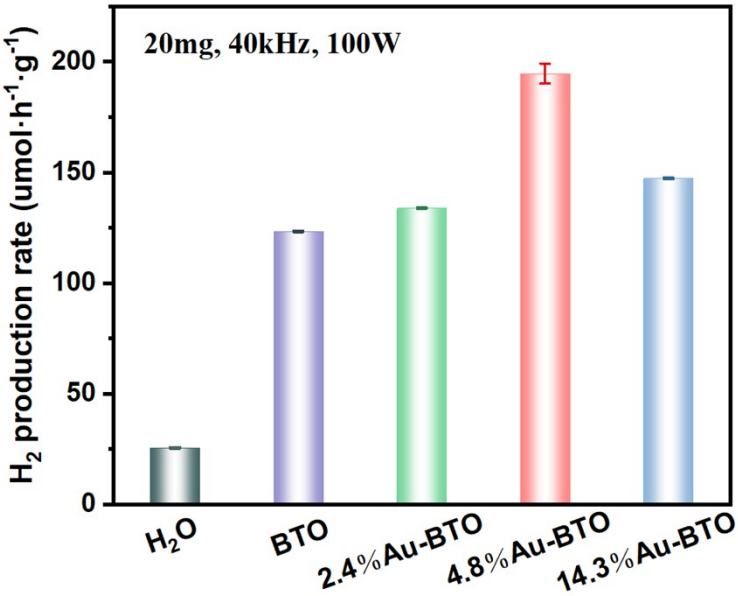

Fig. S4 The H_2 production rate of BTO, 2.4% Au-BTO, 4.8% Au-BTO and 14.3% Au-BTO under ultrasonic vibration of 40 kHz, 100 W.

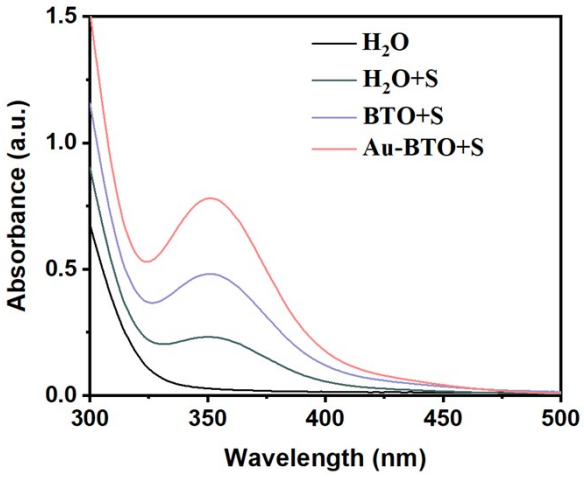

Fig. S5 The absorbance of KI/$H_{32}Mo_7N_6O_{28}$ under ultrasonic vibration (S) of 40 kHz, 100 W.

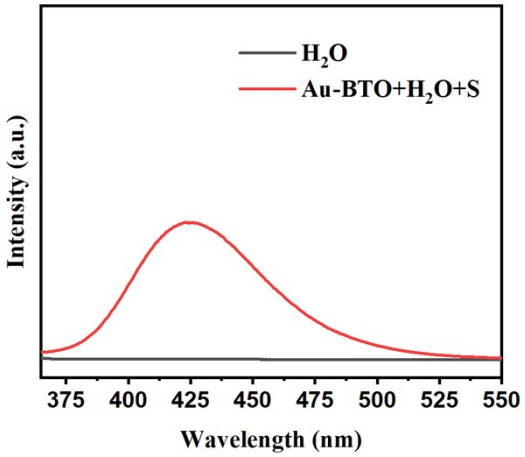

Fig. S6 The fluorescence emission of TA in pure water and Au-BTO suspension after ultrasound.

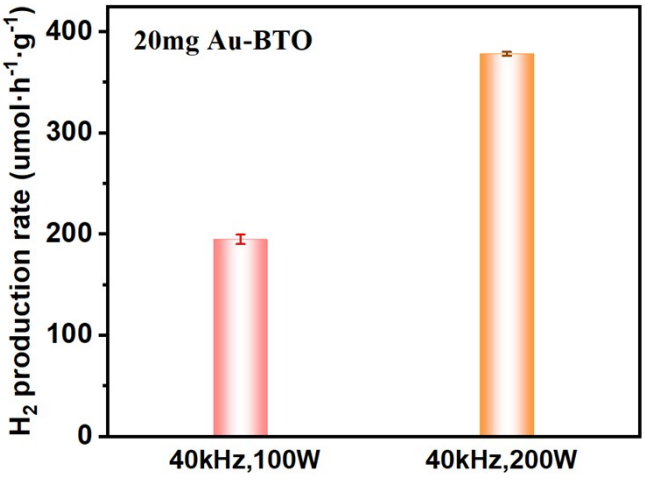

Fig. S7 The H_2 production rate under ultrasonic vibration of 40 kHz with different power over Au-BTO.

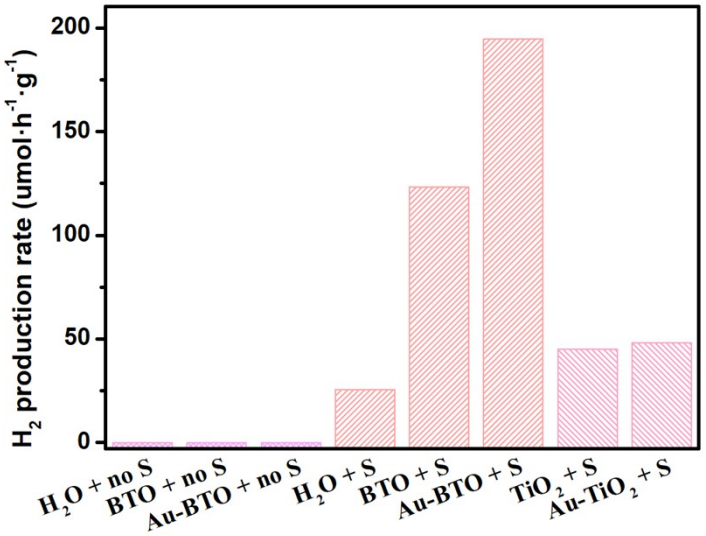

Fig. S8 The H_2 production rate under different condition.

The piezocatalytic activities of BTO and Au-BTO were measured without ultrasonic treatment. And TiO_2 with no piezoelectricity was selected for verification test. The catalytic activities of TiO_2 and Au-TiO_2 (with the same Au content as Au-BTO) were investigated under ultrasonic treatment. As showed in Fig. S8, almost no H_2 is produced over BTO and Au-BTO without ultrasonic treatment, indicating that the piezoelectric potential generated by ultrasonic deformation of the material is an important driving force for carrier participation in the catalytic reaction in piezoelectric catalysis. Notably, TiO_2, without piezoelectricity, also shows a H_2 production rate of 45.03 μmol/h^{-1}/g^{-1} under ultrasonic treatment, which is higher than that of H_2O, while much lower than that of BTO. The result might be attributed to the additional nucleation sites by TiO_2, thus

increasing the number of cavitation events [2, 3]. Besides, the H_2 production rate of Au-TiO_2 is close to that of TiO_2 under ultrasonic treatment, indicating that Au plays almost no role in piezocatalysis when Au is deposited on materials with no piezoelectricy. These results further verify the important role of Au in weakening the charge screening effect of BTO to improve piezocatalytic activity.

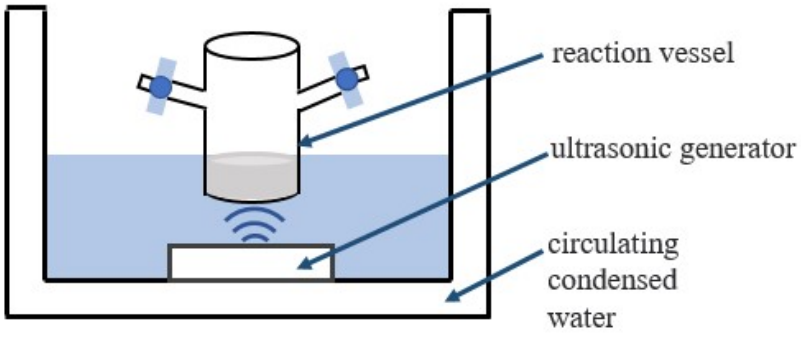

Fig. S9 Schematic diagram of piezocatalytic reaction unit.

References

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3. Y. Zhao, X. Huang, F. Gao, L. Zhang, Q. Tian, Z.-B. Fang and P. Liu, *Nanoscale*, 2019, **11**, 9085-9090.