Synthesis of Nanocrystalline $ATaO_2N$ (A = Ca, Sr, Ba) for Photocatalytic Overall Water Splitting

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Particulate semiconductors having simultaneously a narrow bandgap, high degree of crystallinity and a few tens of nanometer size hold great promise for efficient solar-to-chemical energy conversion, but fabrication of such materials remains a great challenge.[1] This work demonstrates a simple synthetic approach to $ATaO_2N$ (A = Ca, Sr, Ba) nanocrystals by applying TaS_2 and $A(OH)_2$ (A = Ca, Sr, Ba) as the precursor and molten $SrCl_2$ as a flux. The developed approach allows control over different light absorption edges, particle sizes and degrees of crystallinity via tuning the synthetic parameters. As a showcase material, the fabricated $SrTaO_2N$ features a high degree of crystallinity (Fig. 1a), a typical light absorption edge of 600 nm (Fig. 1b), and particle sizes of around 50 nm (Fig. 1c-g). This material exhibited superior photocatalytic sacrificial hydrogen (Fig. 1h) and oxygen (Fig. 1i) evolution performance to the previously reported $SrTaO_2N$ photocatalysts. Efficient Z-scheme OWS applying Ir/Pt/Cr_2O_3-decorated $SrTaO_2N$ as the hydrogen evolution photocatalyst was achieved.

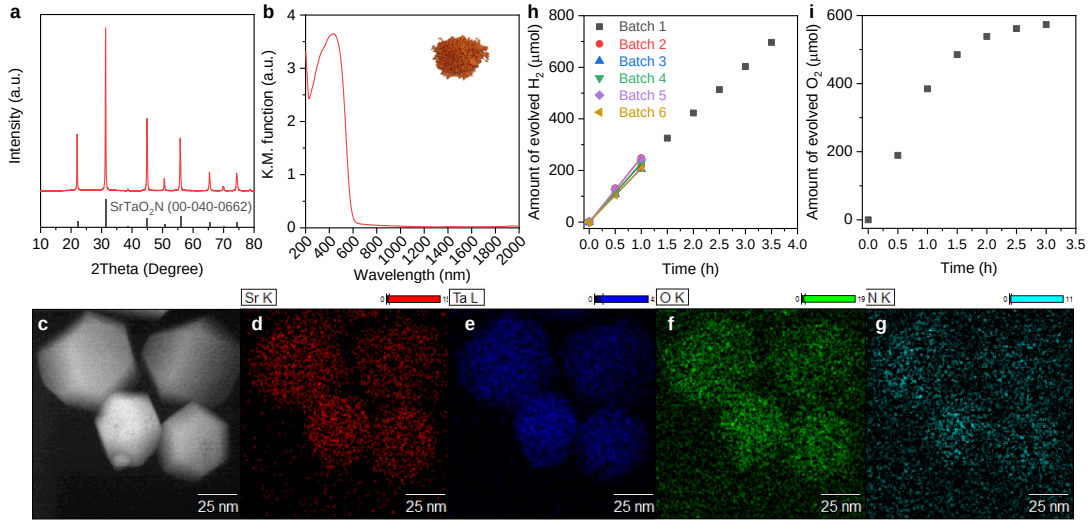

Figure 1. (a) X-ray diffraction pattern, (b) diffuse reflectance spectrum, (c-g) scanning transmission electron microscopy-energy dispersive X-ray spectroscopy maps of the prepared $SrTaO_2N$. Time course of photocatalytic (h) hydrogen and (i) oxygen evolution over Ir/Pt/Cr_2O_3-decorated $SrTaO_2N$ and CoO_x-decorated $SrTaO_2N$, respectively, under visible light.

1) Q. Wang, K. Domen, *Chem. Rev.* **2020**, *120*, 919.