Study on preparation methods for $La_{0.5}Sr_{0.5}Ta_{0.5}Ti_{0.5}O_2N$ photocatalyst

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$La_{0.5}Sr_{0.5}Ta_{0.5}Ti_{0.5}O_2N$ (LSTTON) is a highly active visible-light-driven photocatalyst for sacrificial O_2 evolution [1]. In the present research, we examined preparation methods for oxide precursors.

LSTTON was obtained by nitridation of oxide precursors prepared by a polymerizable complex method under NH_3 flow. Annealing of the oxide precursor in air was performed at 1273, 1473 and 1673 K prior to the nitridation. The samples are referred as LSTTON-*X*, here *X* denotes annealing temperature. The samples were characterized by XRD, SEM and UV-vis DRS. O_2 evolution from an aqueous solution containing $AgNO_3$ (20 mM) as a sacrificial reagent was measured under visible light ($\lambda >$ 420 nm). Photoanodes made from the samples were fabricated as described below. The particles modified with a CoO_x cocatalyst (2 wt% as Co) were deposited on FTO substrate by an electrophoretic deposition [2]. $TaCl_5$ methanol solution (10 mM) was dropped on the as-prepared electrode and the electrode was dried in air at room temperature. After five times repetition of this Ta-modification process, the electrode was heated in NH_3 flow (10 ml/min) at 723 K for 30 minutes. Current-potential curves were measured in a phosphate buffer solution (pH 8) under intermitted visible light irradiation ($\lambda >$ 420 nm).

XRD patterns indicated that all samples were obtained as a single phase of LSTTON and that negligible changes in diffraction intensity and peak position were observed between samples. As shown in Fig.1, primary particles in LSTTON-1673 were larger than other samples. LSTTON-1673 had absorption edge around 590 nm and other samples did around 570 nm. Samples prepared from annealed oxide precursors exhibited lower back ground absorption than the samples without annealing, suggesting the lower amount of reduced Ti/Ta species. LSTTON-1273, -1473, -1673 evolved oxygen at higher rate than the sample without annealing. Activities depended on the annealing temperature, that is, annealing at higher temperature led higher activity. The higher activity would be due to suppression of recombination at defects derived from reduce Ti/Ta species. Fig. 2 shows current potential curve of the LSTTON/FTO photoelectrodes. The electrode made from LSTTON-1673 showed relatively large anodic photocurrent compared to others. As taking into consideration particle size, electrode made from smaller particles showed lower response than one made from larger particles due to large amount of surface defects in the smaller particles.

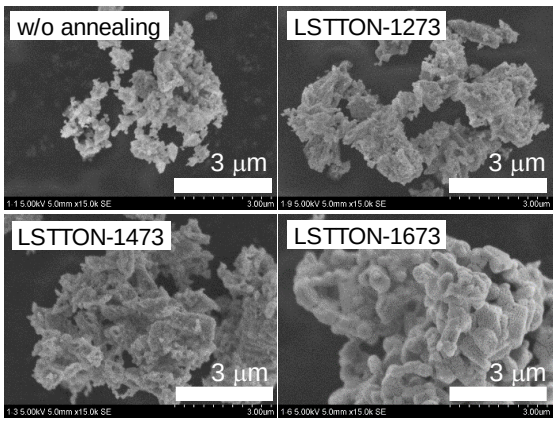

Fig.1 SEM images of LSTTON particles.

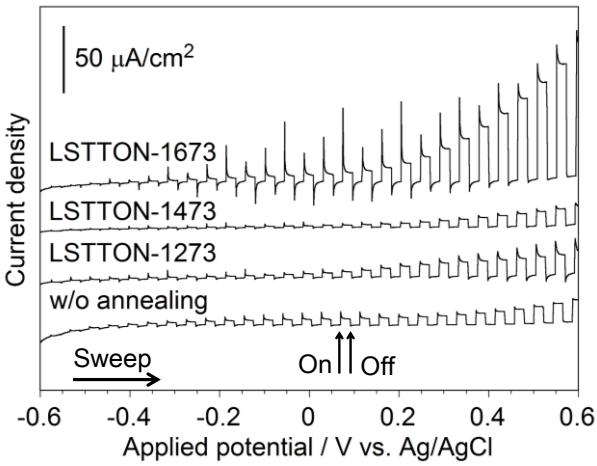

Fig.2 Current-potential curve of LSTTON/FTO electrodes in a phosphate buffer aolution (pH 8) under visible light irradiation ($\lambda >$ 420 nm).

REFERENCES

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