# One-dimensional oxynitride array films for enhanced photoelectrochemical hydrogen production

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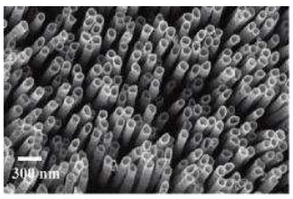
Considerable efforts have been in recent years to design photoactive nanostructured photoelectrodes. Herein, we report on the growth of a novel photoanode material composed of self-ordered, vertically oriented nanotube arrays of oxynitride films via anodization of metal foils in an electrolyte solution of formamide containing $NH_4F$ at room temperature, followed by annealing in an ammonia atmosphere. The nanostructure topology was found to depend on both the anodization time and the applied voltage. Our results demonstrate the ability to grow mixed oxynitride nanotube array films that are several micrometers thick. The oxynitride nanotube array films were utilized in solar-spectrum water photoelectrolysis, demonstrating a ~5-fold increase in the photoconversion efficiency under AM 1.5 illumination (100 mW/cm$^2$, 1.0 M KOH) compared to pure $TiO_2$ nanotubes fabricated and tested under the same conditions. The obtained efficiency is among the highest reported values for a $TiO_2$ nanotube-based photoelectrochemical cell. This enhancement in the photoconversion efficiency is related to the synergistic effects of alloying elements, nitrogen doping, and the unique structural properties of the fabricated nanotube arrays.




References

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2. N. K. Allam et al., Chem. Phys. Lett., 2012, 549, 62-66.