Water-splitting photocatalyst that is abundant and inexpensive with low toxicity discovered

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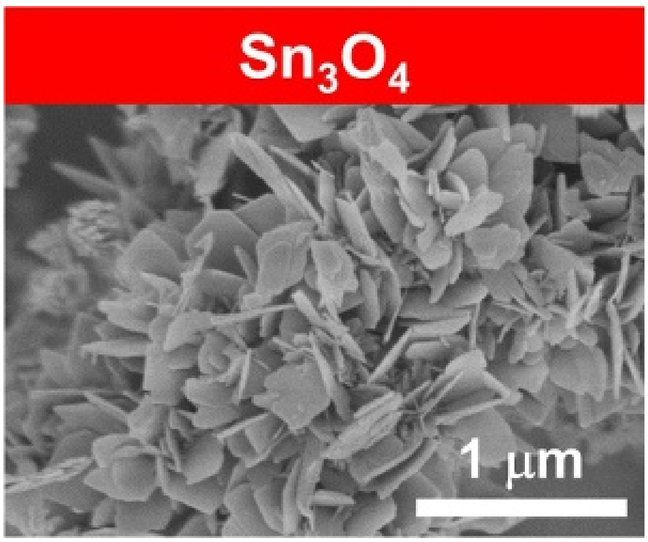

Figure 1 from the press release material. Electron microscope imagery of Sn3O4 catalyst. The synthesized material is a collection of microsized (one millionth of a meter) flaky crystals.

As a part of JST's problem-solving oriented basic research program, the research group led by the principal researcher Hideki Abe and the senior researcher Naoto Umezawa at the NIMS's Environmental Remediation Materials Unit discovered a new photocatalyst, Sn3O4, which facilitates the production of hydrogen fuel out of water using sunlight as an energy source.

Technology that allows direct conversion of sunlight, an ultimate renewable energy, into chemical energies (i.e., fuels) that can be condensed and transported is not yet available. As such, solar energy is not ready at present to be utilized in place of conventional fossil and nuclear fuels.

Many water-splitting photocatalysts, such as titanium dioxide (TiO_2), can decompose water and produce hydrogen fuel when absorbing ultraviolet light. However, due to their inability to absorb visible light, which accounts for more than half of solar energy, their practical use in the conversion of solar energy is limited. While the development of new photocatalysts that are able to split water by absorbing visible light has been worked on globally, there are cost- and environment-related issues because many of the available photocatalysts contain expensive rare metals, such as tantalum, or high concentrations of lead, which is very toxic.

We recently discovered a novel photocatalyst through the approach of integrating both theoretical and experimental sciences. We searched for oxides containing divalent tin ions (Sn^{2+}) based on the theoretical prediction that such substances may have an electronic structure conducive to water-splitting photocatalytic reactions under the presence of visible light. As a result, we found a tin oxide, Sn_3O_4 ($Sn^{2+}2Sn^{4+}O_4$), that is made up of divalent tin ions (Sn^{2+}) and tetravalent tin ions (Sn^{4+}). Our experiment revealed that this substance facilitates a water-splitting reaction leading to the generation of hydrogen when exposed to visible light which does not activate TiO_2.

Since tin oxides are relatively non-toxic, inexpensive and abundant, they are widely used as transparent conductive materials. The discovery of the Sn_3O_4 catalyst is expected to greatly contribute to the reduction of environmental load and costs associated with hydrogen fuel production, and to the realization of a recycling-oriented society founded on the use of solar energy.

The results of this research will be published in the near future in the online version of *Applied Materials & Interfaces*, a journal issued by the American Chemical Society.

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