

# Research Highlights

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## A Nanoparticle Boost for Solar-powered Water Heating

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**A highly-efficient, nanoparticle-based method for heating water and generating water vapor from sunlight is demonstrated by WPI-MANA scientists.**

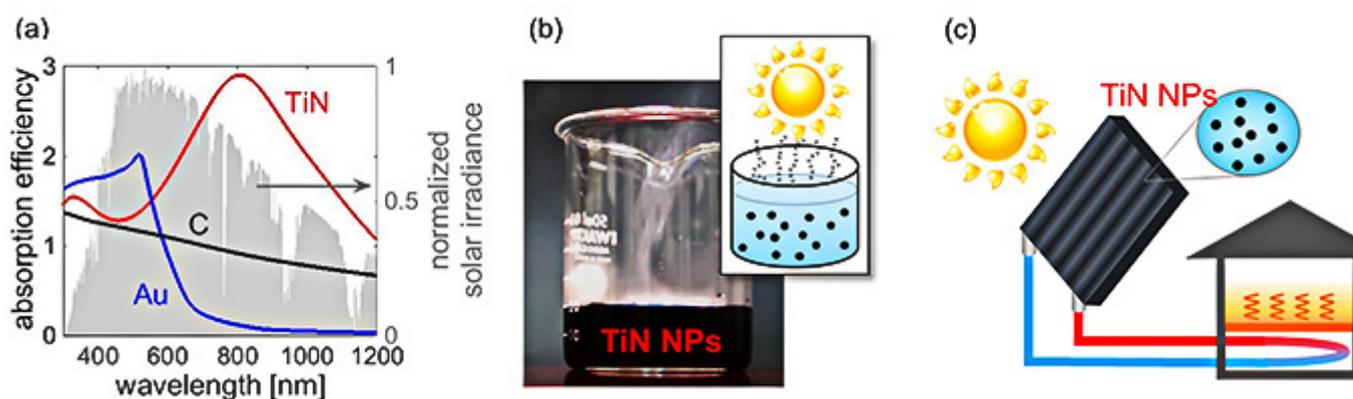


Figure 1.

- (a) Absorption efficiencies of single nanoparticles (left axis) made of TiN, gold (Au) and carbon (C). The right axis shows normalized solar irradiance.
- (b) Photograph showing vapor generating from water containing TiN nanoparticles (TiN NPs) in room temperature under the illumination of focused sunlight. The inset figure illustrates the photograph.
- (c) Schematic of a solar heater using TiN NP dispersed water.

Solar energy could provide a renewable, sustainable source of power for our daily needs. However, even the most state-of-the-art solar cells struggle to achieve energy conversion efficiency of higher than 30%. While current solar-powered water heaters fare better in terms of energy efficiency, there are still improvements to be made if the systems are to be used more widely.

One potential candidate for inclusion in solar water heaters is “nanofluid,” that is, a liquid containing specially-designed nanoparticles that are capable of absorbing sunlight and transforming it into thermal energy in order to heat water directly. Now, Satoshi Ishii and his co-workers at the International Center for Materials Nanoarchitectonics (WPI-MANA) and the Japan Science and Technology Agency have developed a new nanofluid containing titanium nitride (TiN) nanoparticles, which demonstrates high efficiency in heating water and generating water vapor.

The team analytically studied the optical absorption efficiency of a TiN nanoparticle and found that it has a broad and strong absorption peak thanks to lossy plasmonic resonances. Surprisingly, the sunlight absorption efficiency of a TiN nanoparticle outperforms that of a carbon nanoparticle and a gold nanoparticle (see Figure 1(a)).

They then exposed each nanofluid to sunlight and measured its ability to heat pure water. The TiN nanofluid had the highest water heating properties, stemming from the resonant sunlight absorption as shown in Figure 1(b). It also generated more vapor than its carbon-based

counterpart. The efficiency of the TiN nanofluid reached nearly 90%. Crucially, the TiN particles were not consumed during the process, meaning a TiN-based heating system could essentially be self-sustaining over time.

TiN nanofluids show great promise in solar heat applications, with high potential for use in everyday appliances such as showers and heaters (see Figure 1(c)). The new design could even contribute to methods for decontaminating water through vaporization.

## Reference

"Titanium nitride nanoparticles as plasmonic solar heat transducers"

[Satoshi Ishii](#), Ramu Pasupathi Sugavaneshwar and [Tadaaki Nagao](#)

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