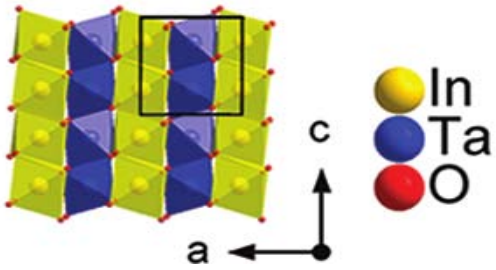
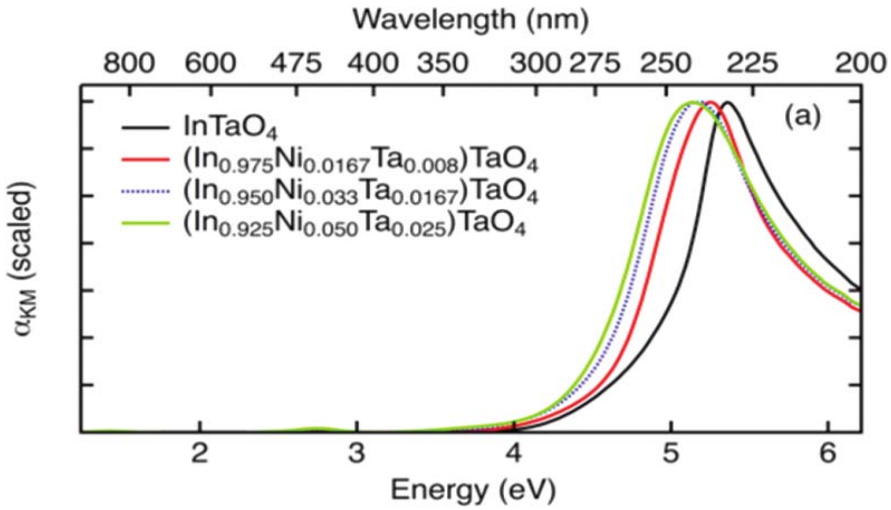
NSLS Enables Critical Assessment of Proposed Solar Material

- Researchers have gained valuable information about a material being investigated for use in an emerging technology for renewable energy production: using sunlight-absorbing semiconductors to split water molecules and yield hydrogen gas, which can be fed into a fuel cell to generate electricity or used as fuel itself.
- The group studied indium tantalate ($InTaO_4$) – a compound of indium, tantalum, and oxygen – "doped" with nickel (Ni) atoms, which had been deemed promising. They concluded that its composition is different than suggested and, therefore, it does not absorb sunlight well.
- At beamline X19A, they used x-ray absorption near-edge spectroscopy to observe that the Ni atoms take the form Ni^{2+} ions, not Ni^{3+} as previously suggested. They used x-ray diffraction (beamline X16C) to determine the phase composition at different Ni doping levels.
- The group found that Ni-doped $InTaO_4$ does not have the properties it needs to absorb sunlight. Most notably its band gap – a measure of its ability to absorb and retain light – is too large, making the compound transparent to sunlight.





Top: A representation of the crystal structure of $InTaO_4$ prior to doping. Bottom: Optical absorption data of $InTaO_4$ for different levels of doping. The curves show that Ni doping does not significantly lower the band gap, which remains at nearly 4 eV. Most solar energy is found at 3 eV and below.

Andrew C. Malingowski, et al. "Substitutional Mechanism of Ni into the Wide-Band-Gap Semiconductor InTaO4 and Its Implications for Water Splitting Activity in the Wolframite Structure Type" Inorg. Chem. 2012, 51, 6096-6103