Scilight

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Tungsten disulfide nanotubes demonstrate useful luminescent behavior

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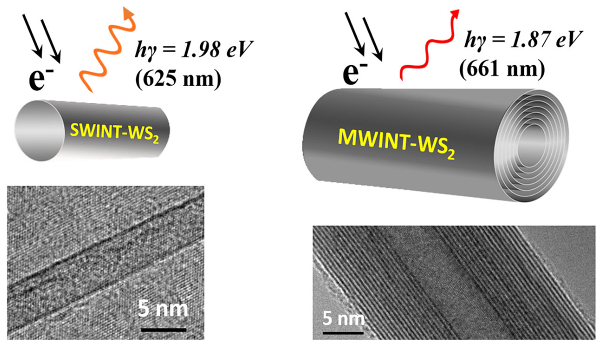
Quantum confinement in tungsten disulfide nanotubes could allow for tunable electronic structures and a multitude of new applications.



With different electro-optical properties than their bulk counterparts, interest in nanotubes has exploded. Initially, nanotubes were built from carbon, but researchers are increasingly exploring other inorganic materials. Ghosh et al. studied the electro-optical behavior of single wall tungsten disulfide nanotubes for the first time and discovered interesting new luminescent properties.

The researchers developed an improved production method for these nanotubes. Tungsten disulfide nanotubes have wider tri-atomic layers than their monoatomic carbon counterparts and, therefore, require highly energetic conditions to roll the layers into nanotubes.

“It was not simple to synthesize these single- and double-layered nanotubes,” said author Alla Zak. “But enhancing our high-power plasma method allowed us to create many of them and, thus, finally study their properties.”

Testing the tungsten disulfide nanotubes through electron microscopy and spectroscopy, the researchers observed cathodeluminescence — luminescence when bombarded with electrons. The single-wall and multiwall nanotubes were found to luminesce at different wavelengths, due to differences in their band gap energies. The cathodoluminescence of the single-wall nanotubes was consistent with quantum confinement.

“We experimentally demonstrated there’s a variance in band gaps between single-layer and multi-layer nanotubes,” Zak said. “It will be interesting if we can show in the future a band gap dependence on number of layers.”

Already, the computer simulations have confirmed differences in band gap energies between single- and double-walled tungsten disulfide nanotubes and suggested similar behavior for the higher numbered layers. Due to these properties, such inorganic nanotubes could have many applications as photodetectors, photocatalysts in hydrogen production, field effect transistors and other switchable electronics.

Source: “Cathodoluminescence in single and multiwall WS_2 nanotubes: Evidence for quantum confinement and strain effect,” by S. Ghosh, V. Brüser, I. Kaplan-Ashiri, R. Popovitz-Biro, S. Peglow, J. I. Martínez, J. A. Alonso, A. Zak, *Applied Physics Reviews* (2020). The article can be accessed at https://doi.org/10.1063/5.0019913.