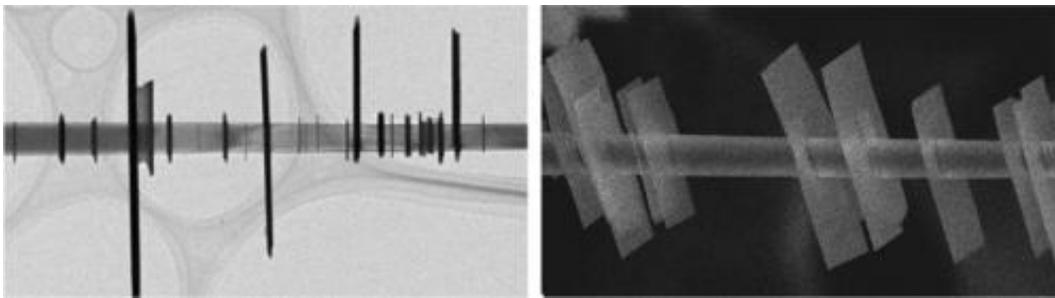


Semiconductor 'shish kabob' nanostructures combine properties from different dimensions

March 27 2013, by Lisa Zyga



2D nanosheets grown on a 1D nanowire can combine the advantages of both dimensionalities and may enable novel functions that cannot be obtained from each of the components separately. Credit: Chun Li, et al. ©2013 American Chemical Society

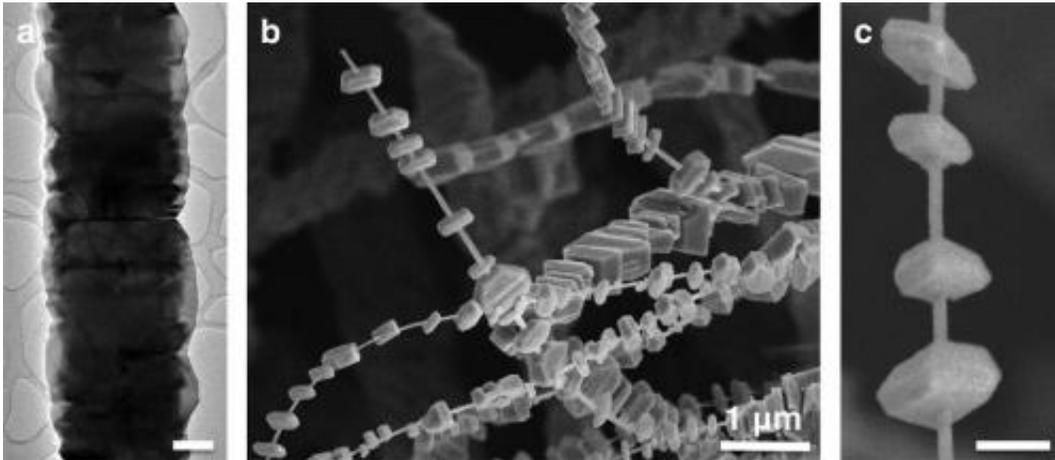
(Phys.org) —By growing 2D nanosheets along the surface of a 1D nanowire, scientists have synthesized a new 3D nanoscale heterostructure that they call—for appropriate reasons—"shish kabobs." Due to the integration of the two dimensionalities, the new structures could have a wide variety of applications, such as for solar energy conversion, energy storage, and photonics.

The scientists, Chun Li, et al., at North Carolina University in Raleigh, North Carolina; and Oak Ridge National Laboratory in Oak Ridge, Tennessee, have published a paper on the nanosheet-nanowire

heterostructures in a recent issue of *Nano Letters*.

So far, most research on growing [nanoscale](#) heterostructures has focused on combining materials that have the same dimensions. Studies that involve combining materials with different dimensions have remained limited because it is much more difficult to integrate these materials into a single structure due to their different [growth mechanisms](#).

However, as the researchers here explain, integrating materials with different dimensions is attractive because it can combine the advantages of both materials while mitigating the disadvantages. As a result, such heterostructures may enable novel functions that cannot be obtained from each of the components separately.



SEM images of nanosheet-nanowire heterostructures. The researchers found that air exposure facilitates the nucleation of nanosheets by modifying the surface of the nanowire. Credit: Chun Li, et al. ©2013 American Chemical Society

To synthesize the new nanosheet-nanowire structures in this study, the researchers used a two-step approach, first growing the [nanowires](#) and

then growing the nanosheets at certain sites on the nanowires. They used [germanium](#) sulfide as the material for both components, but predict that the same approach will apply to other similar materials.

In order to yield nanowire-nanosheet heterostructures, the researchers exposed the grown nanowires to air for a few minutes to a few days prior to the nanosheet growth step. The air exposure likely causes mild oxidation on the surface of the nanowires, which changes its surface properties. The researchers think that these surface imperfections may facilitate the nucleation of the nanosheets better than a perfect surface can.

After the nanowires were exposed to air, the researchers could successfully grow nanosheets on the nanowire surface along the radial direction, so that they were arranged like pieces of chicken and peppers on a skewer. Besides their appeal due to this unusual architecture, the nanowire-nanosheet heterostructures also have an appealing combination of characteristics, notably a large surface area due to the 2D nanosheets and efficient charge transport due to the 1D nanowire. For these reasons, the new nanostructures could have applications in photovoltaics, supercapacitors, lithium-ion batteries, 3D optoelectronics, and chemical sensing.

More information: Chun Li, et al. "Epitaxial Nanosheet-Nanowire Heterostructures." *Nano Letters*. [DOI: 10.1021/nl303876a](https://doi.org/10.1021/nl303876a)

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Citation: Semiconductor 'shish kabob' nanostructures combine properties from different

dimensions (2013, March 27) retrieved 22 September 2024 from
<https://phys.org/news/2013-03-semiconductor-shish-kabob-nanostructures-combine.html>

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