

## Antibacterial surfaces on biomedical devices

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Fig. 1: Future electric vehicle using structural battery composites from multifunctional carbon fibres.

**What is it?** Using graphene spikes, vertically aligned on various surfaces, scientists at Sweden's Chalmers University of Technology developed coatings that efficiently prevent attachment of pathogenic bacteria. Over 99.99% of approaching bacteria get killed by vertical graphene spikes.

**Why does it matter?** Treatment of many chronic diseases and medical conditions requires various medical devices that need to stay inside the body or in contact with the body for very long periods: e.g. implants, catheters, prosthetic devices. These devices are prone to accumulating bacteria on their surfaces, and this can lead to very dangerous chronic infections in the affected patients. Enhancing these surfaces with antibacterial properties reduces the risk for patients, as well as prolongs the duty cycle of such devices, thus leading to more sustainable medical solutions with reduced environmental footprint.

**How does it work?** Graphene spikes are hydrophobic, and if they approach the bacterial surface at the right angle ( $90^\circ$ ), they can puncture a hole in the bacterial membrane. This "wound" does not heal easily, and ultimately all content of the bacterial cell leaks out, and bacteria die. Size and density of graphene spikes in the coating can be optimized to make them harmless to human cells. Recently, graphene spikes have been successfully mixed with polymers, and plastic surfaces with antibacterial properties were thus created – opening up a very broad field of antibacterial applications.

**Publication** Pandit S, Cao Z, Mokkaapati VRSS, Celauro E, Yurgens A, Lovmar M, Westerlund F, Sun J, Mijakovic I. *Vertically aligned graphene coating is bactericidal and prevents the formation of bacterial biofilms*. *Adv Mater Interfaces* 5: 1701331 (2018).

**Patent** M. Lovmar, S. Pandit, VRSS. Mokkaapati, J. Sun. *Antibacterial coating or surface comprising vertical, standing angstrom scale flakes*. US Patent: Pub. No.: US 2018/0320002 A1, Nov. 8, 2018.

## Media coverage

**111 news publications** with a potential reach of 42,7 million readers

Spikes of graphene can kill bacteria on implants

<https://phys.org/news/2018-04-spikes-graphene-bacteria-implants.html>

<https://www.sciencedaily.com/releases/2018/04/180416085929.htm>

<https://www.news-medical.net/news/20180416/Tiny-layer-of-graphene-flakes-becomes-deadly-weapon-against-bacteria-on-implants.aspx>

<http://www.periodistadigital.com/salud/medicina/2018/05/05/sabias-que-colocar-una-pequena-capade-grafeno-en-los-implantes-evita-la-aparicion-de-infecciones.shtml>

<https://sverigesradio.se/sida/artikel.aspx?programid=406&artikel=6932122>

[https://www.eurekalert.org/pub\\_releases/2018-04/cuot-sog041318.php](https://www.eurekalert.org/pub_releases/2018-04/cuot-sog041318.php)

[https://www.eurekalert.org/pub\\_releases/2018-04/cuot-sog041318.php](https://www.eurekalert.org/pub_releases/2018-04/cuot-sog041318.php)

<http://www.digitaljournal.com/tech-and-science/science/graphene-spikes-kill-pathogenic-bacteria/article/520542>

<https://www.theengineer.co.uk/vertical-graphene-spikes-bacteria/>

<https://scienmag.com/spikes-of-graphene-can-kill-bacteria-on-implants/>

<https://www.scitecheuropa.eu/graphene-kill-bacteria/85919/>

<https://www.medicalnewser.com/2018/04/17/researchers-use-graphene-to-disrupt-biofilms.html>

<http://www.columbusindian.net/desi/newsdetail.asp?id=355049>

<http://www.sacramentoindian.com/desi/newsdetail.asp?id=355049>

<http://www.newyorkindian.com/desi/newsdetail.asp?id=355049>