Research clarifies the physics of water repelling surfaces

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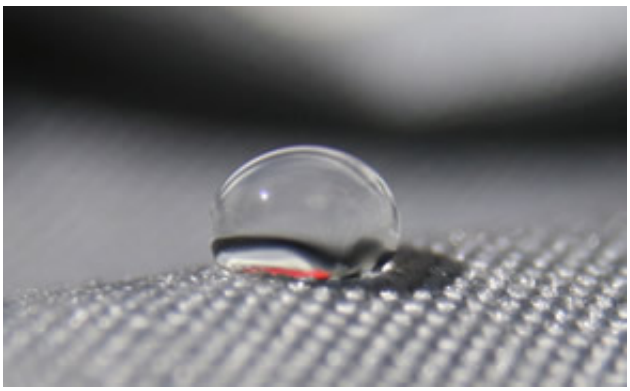

"Water droplet at DWR-coated surface1" by Brocken Inaglory. Licensed under CC BY-SA 3.0 via Wikimedia Commons.

Researchers have gained valuable insights into the behaviour of water on strongly hydrophobic (water-repelling) surfaces. Understanding this behaviour should help scientists develop new types of surfaces with applications ranging from textiles to surgical tools.

In a GW4 collaboration, Professor Nigel Wilding and Professor Robert Evans of the University of Bristol used Bath's High Performance Computer to simulate the properties of water at hydrophobic surfaces at a molecular level.

The work, published today in *Physical Review Letters*, reveals that the physics of hydrophobic surfaces is controlled by a phenomenon known

as critical drying.

When water is placed on a substance that is hydrophobic, it reduces its contact with the substance by rolling up into a drop, like rain on a freshly waxed car. The more hydrophobic a surface is, the larger the contact angle between the drop and the surface becomes, making the drop more round.

For extreme hydrophobicity the contact angle is 180°, the drop is spherical in shape, and we say that the substance is "dry".

Professor Wilding explained: "Previously the nature of the dry state has been poorly understood.

"Our simulations have established that it is an example of a surface critical phenomenon. This is because as the contact angle approaches 180°, the compressibility of water close to the surface diverges to infinity.

"At a microscopic level this means that the density of water molecules near the surface undergo huge fluctuations: some regions have a liquid-like density, while others will have a much lower vapour-like density.

"We have shown that critical drying causes these density fluctuations near hydrophobic surfaces, even for contact angles much less than 180°."

More information: *Physical Review Letters*, journals.aps.org/prl/abstract/ … ysRevLett.115.016103

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