


Understanding Physics and Physical Chemistry Using Formal Graphs

WATER-REPELLING CHEMISTRY

All sorts of materials can be made water-repellent with simple coatings. As the rainy season approaches, we examine some of these coatings and the particular methods they use to keep dry.


CONTACT ANGLES & HYDROPHOBICITY

Scientists judge how well a surface repels water by the contact angle created when a water droplet is placed on it. The contact angle is defined as the angle formed where the outside of the droplet meets the surface it is resting on.



$\theta < 90^\circ \rightarrow$ **HYDROPHILIC**


Hydrophilic surfaces are "water loving." Water spreads on them easily and isn't repelled much.



$\theta > 90^\circ \rightarrow$ **HYDROPHOBIC**

Hydrophobic surfaces are "water hating." Water beads up on them because the materials they're made of—often times polymers such as polysiloxanes or polyfluorinated compounds—don't interact much with the liquid.

HOW ARE MATERIALS MADE WATER-REPELLENT?




$\left[\begin{array}{c} \text{F} & \text{F} \\ | & | \\ \text{---C---} & \text{---C---} \\ | & | \\ \text{F} & \text{F} \end{array} \right]_n$

WATERPROOF CLOTHING

PTFE
(POLYTETRAFLUOROETHYLENE)

Many waterproof coats use Gore-Tex, a material containing polytetrafluoroethylene (PTFE), to help them repel water. PTFE is also a material that can make Teflon pans nonstick.




$\left[\begin{array}{c} \text{CH}_3 \\ | \\ \text{---O---Si---} \\ | \\ \text{CH}_3 \end{array} \right]_n$

CAR WINDSHIELD TREATMENTS

PDMS
(POLYDIMETHYLSILOXANE)

Car body, windshield, and glass treatments such as Rain-X use compounds called polysiloxanes as the active ingredient to achieve their hydrophobicity.



URINE-REPELLING WALL PAINT

TEXTURED MICROSCALE STRUCTURE

Cities such as San Francisco have tested whether coating walls with a hydrophobic paint can deter public urination. The paint creates a textured microscale structure on a wall that, coupled with hydrophobic compounds, splashes urine back on public urinators.

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