Pouring oil on troubled waters – scientists solve secrets of the water-oil interface

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Understanding the oil-water interface will be useful in many areas, including designing better detergents.

(PhysOrg.com) -- When oil and water are poured together they meet each other head-on to form a strong and rigid boundary between each other, says new research into how interactions between oil and water work, out this week in *Physical Review Letters*.

This discovery contradicts previous research which suggested that when oil and water meet, a tiny layer of water vapour, invisible to the human eye, forms between them, keeping them apart and creating a weak and fluctuating boundary between the two substances.

Oils are hydrophobic substances which means they repel water, and cannot mix with water. This is illustrated by the way any kind of oil and water remain separate if they are poured into the same cup.

Scientists are interested in understanding exactly how this separation works because these oil-water boundaries play a key role in many chemical and biological processes, from the design of detergents to the function of oily biological membranes, such as the walls of human cells which enclose the watery contents of the cell.

However, analysing the structure of the oil-water interface is very difficult because it fluctuates, moves around and changes as the oil and water themselves move and flow.

The team behind the new study have used computer simulations of water and oil to produce, for the first time, a clear picture of the oil-water interface, without the blurring and lack of clarity that is caused by the movements of the liquids. The computer models show that there is no thin layer of water vapour between the oil and the water as had been predicted – instead the two liquids were shown to be in direct contact with each other along the length of a boundary which was strong and robust, and not weakly fluctuating as expected.

Dr Fernando Bresme from Imperial College London's Department of Chemistry, one of the authors on the new paper, explained the significance of their findings, saying: "This study is one step towards a greater insight into the relationship between oily substances and water at the molecular level - an area of fundamental science which is relatively little-understood, but which has enormous potential for industry, medicine and nanotechnology.

"It was very interesting to see that our results suggest there is no tiny gap between oil and water when they meet. Despite having a reputation for

not liking each other, it seems the opposite is true: they may not be able to mix but they come into full contact with each other at a strong interface. Perhaps they like each other more than we previously thought."

Citation: 'Intrinsic Structure Hydrophobic Surfaces: The Oil-Water Interface', Physical Review Letters, online publication 1 August 2008.

Provided by Imperial College London

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