Methods of Restoring and Maintaining Gas Film on Superhydrophobic Surfaces while Underwater

Tech ID: 22142 / UC Case 2011-040-0

SUMMARY

UCLA researchers in the Department of Mechanical and Aerospace Engineering have developed a method of maintaining and restoring a gas film on a superhydrophobic surface while underwater.

BACKGROUND

A liquid interfaced directly with a solid creates frictional forces. For example, these frictional forces slow down a boat traveling through the water and require it to use more power and fuel. A gas film layer between the solid and liquid interfaces would act to reduce frictional forces because the frictional drag of a liquid flowing over a gas film is lower than that of a liquid flowing directly over a solid.

Despite its usefulness, such a gas film layer is thermodynamically unstable. The gas film destabilizes from many different factors, including high liquid pressure, gas diffusion into the liquid, or physical defects on the surface - all of which are inevitable in most real life applications. Past research in the field focused on how to make the superhydrophobic surfaces more robust to prevent the gas film from destabilizing. None were directed at restoring and maintaining the gas film once it is disturbed.

INNOVATION

Researchers at UCLA have identified methods to re-establish a gas film on a structured hydrophobic surface underwater when the gas film is disrupted or depleted. The new methods immediately restore the gas film when a breakdown begins, thereby ensuring that a gas film is sustained for a sufficiently long time under various harsh conditions.

APPLICATIONS

- Water craft manufacturing
- Water sports including surfing, wind sailing, water skis, etc.
- Any physical device that functions in water

ADVANTAGES

- Reduction of frictional drag under laminar and turbulent flow conditions
- Lower fuel costs
- Increase speed
- Prevent solid surface damage

STATE OF DEVELOPMENT

The current methods have been demonstrated and experimentally verified using superhydrophobic surfaces.

PATENT STATUS

Country	Type	Number	Dated	Case
Germany	Issued Patent	60 2011 072 751.6	04/13/2022	2011-040
France	Issued Patent	2598433	04/13/2022	2011-040
United Kingdom	Issued Patent	2598433	04/13/2022	2011-040
United States Of America	Issued Patent	10,125,271	11/13/2018	2011-040

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INVENTORS

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OTHER INFORMATION

KEYWORDS

gas film, superhydrophobic surface, thermodynamics, frictional drag

CATEGORIZED AS

- **Materials & Chemicals**
  - Thin Films

RELATED CASES

2011-040-0

Republic Of Korea (South Korea)	Issued Patent	10-1906613	10/02/2018	2011-040
Japan	Issued Patent	6320754	04/13/2018	2011-040
United States Of America	Issued Patent	9,314,818	04/19/2016	2011-040
China	Issued Patent	ZL 2011800466557	03/23/2016	2011-040

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Membraneless Fuel Cell with Self-Pumped Fuel and Oxidant
- A Low-Profile Flow Shear Sensing Unit
- Complete Transfer of Liquid Drops by Modification of Nozzle Design
- Stereo Image Acquisition By Lens Translation
- Method of Fluid Manipulation By Electrodewetting
- Method for Commercial Production of Super-Hydrophobic Materials
- A Built-In Mechanism Of Gas Maintenance In Microfeatures On A Submerged Surface
- No-Assembly Devices for Microfluidics Inside a Cavity
- Liquid-Repellent Surfaces Made of Any Materials
- On-chip, Real-time Feedback Control for Electrical Manipulation of Droplets
- Micropumping of Liquids by Directional Growth and Selective Venting of Bubbles
- Microstructured Cathode for Self-Regulated Oxygen Generation and Consumption

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