nees institut für Biodiversität der Pflanzen Universität Bonn

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Group „Biodiversity and Biomimetics“

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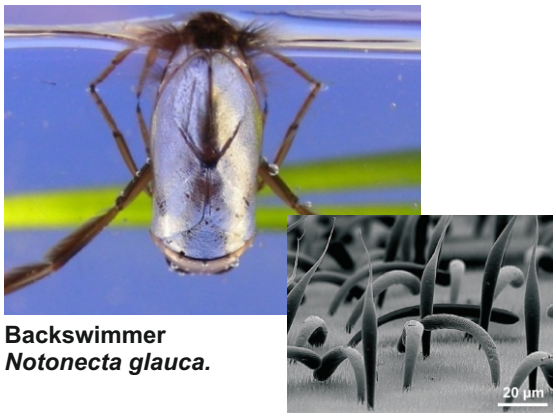
www.nees.uni-bonn.de / www.lotus-salvinia.de

Air Retaining Surfaces:
Ship Coatings Inspired by Nature

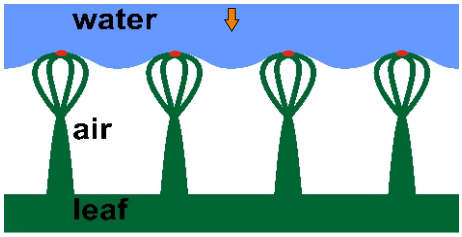
Floating fern
Salvinia molesta.

A considerable part of a ship's total energy consumption is used to overcome friction between the ship hull and the surrounding water. This friction could drastically be reduced by an air layer separating water and ship. During our work on air retaining surfaces in 2007 the Salvinia effect was discovered providing a bio-inspired mechanism for permanent air-retention under water.

The biological models, the floating ferns *Salvinia* and the backswimmer *Notonecta*, are capable of keeping an air layer under water due to their water repellent, hairy surfaces. The hairs of the backswimmer are thereby declined in a way to to stabilize the air layer while swimming.

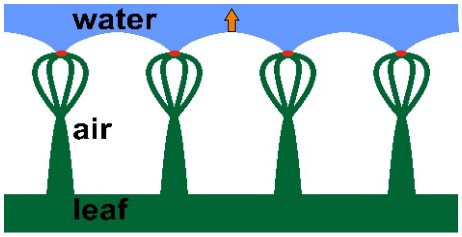


Backswimmer
Notonecta glauca.



Under normal conditions the water just lies on top of the hydrophobic hairs.

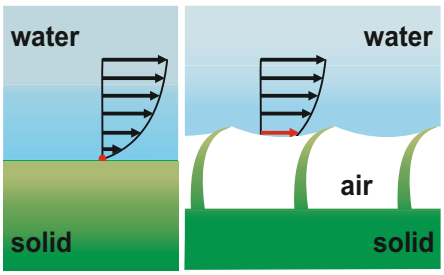
The leaves of the floating fern *Salvinia molesta* on the other hand are designed for long term stability. Four hydrophilic (water loving) cells at the tips of each hydrophobic, complex structured hair stabilize the kept air layer for weeks.



In case of negativ preasure differences the hydrophilic patches pin the water and thereby prevent the formation of air bubbles.

Prototypic flock surface. The silvery shine at the ship hull indicates a kept air layer.

In cooperation with scientists from the Karlsruhe Institute of Technology (KIT) and the university of Rostock we work on the recognition and abstraction of the underlying principles to develop an artificial air retaining and therefore drag reducing coating. First technical prototypes already revealed a friction reduction of over 30% and shall now be developed further into a ship coating.



The friction between water and solid is reduced by an air layer mounted inbetween.

Further Information: www.nees.uni-bonn.de / www.lotus-salvinia.de

W. Barthlott, Th. Schimmel, S. Wiersch, K. Koch, M. Brede, M. Barczewski, S. Walheim, A. Weis, A. Kaltenmaier, A. Leder and H. F. Bohn (2010). The Salvinia Paradox: Superhydrophobic Surfaces with Hydrophilic Pins for Air Retention Under Water. *Advanced Materials* **22**(21): 2325-2328.

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