Research: Austria Young Physicists' Tournament, AYPT 2016, Austria
STEM Fellowship Journal, 2017, 3(1): 23-29,https://doi.org/10.17975/sfj-2017-004

Ultra-Hydrophobic Water

10.17975/sfj-2017-004

AUTHORS: Rozhina Sedigh
SCHOOL: Farzanegan 2 High School

Abstract

When a drop of a viscous fluid is deposited on a bath of the same fluid that is vibrating, it is shown that it coalesces with this substrate or lifts off when the vibration of the surface is larger than g, leading to a steady condition where a drop can be kept bouncing for any length of time, as shown in figure 1. The phenomena that will occur depends on various parameters, such as drop impact acceleration, liquid surface tension, density, dynamic viscosity, gravity, droplet radius and impact speed, bath vibration frequency and amplitude. The effect of different parameters will conclude to a set of conditions which results in a system, called "ultra-hydrophobic water" which plays important role in chemical micro fluidic applications.

Key Words

Ultra-hydrophobic, Soapy Water, Loudspeaker, Vibrator, Small droplets

Introduction

The impact of a liquid drop on a quiescent liquid bath has been widely studied due to its visual appeal and its importance in both natural processes and industrial applications. Physicists found thatafter a droplet falls on the surface of the same liquid, it will bounce several times before merging with the liquid. Back in 2005, Couder discovered that upon placing a silicon droplet on the surface of a bath of the same liquid, the droplet will not coalesce under certain conditions and will instead stay on the liquid surface for a period of time. Such a lubricating film can delay or completely avoid coalescence, as shown in figure 2.

This phenomena depends on various parameters such as drop impact acceleration, liquid surface tension, density, dynamic viscosity, gravity, droplet radius and impact speed, bath vibration frequency and amplitude.

In this study, the theory of this phenomenon will be explained both theoretically and using an experimental set up, where different parameters were investigated.

Materials and Methodology

Using high speed cameras, it has been shown that when a liquid droplet falls on the surface of the same liquid, it doesn't submerge immediately; it will bounce several times, go in and come out of the liquid and finally submerge into the liquid. This all happens within a very short period, which is why coalescence is the only observation made at the impact time.

To extend the duration of time during which the droplet will stay

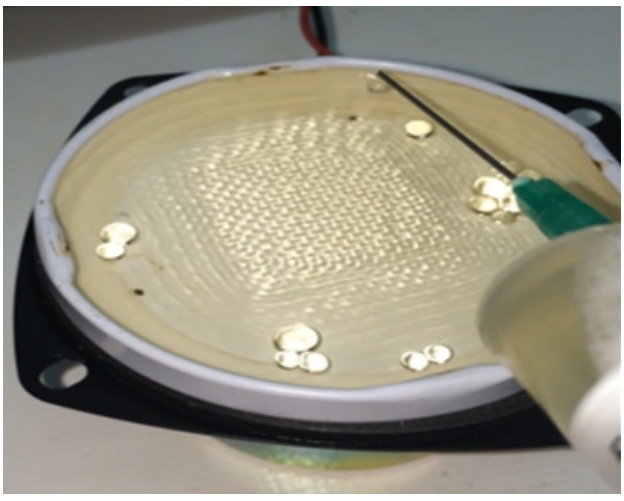

Figure 1: Smaller drops stay (bounce) more and longer on the water surface.

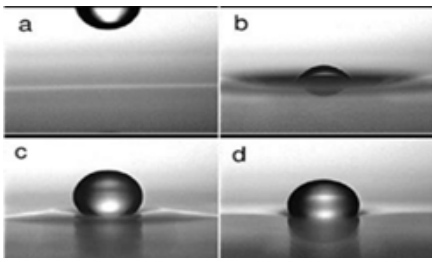

Figure 2: Four steps of sitting a droplet on the liquid surface after impact [1].