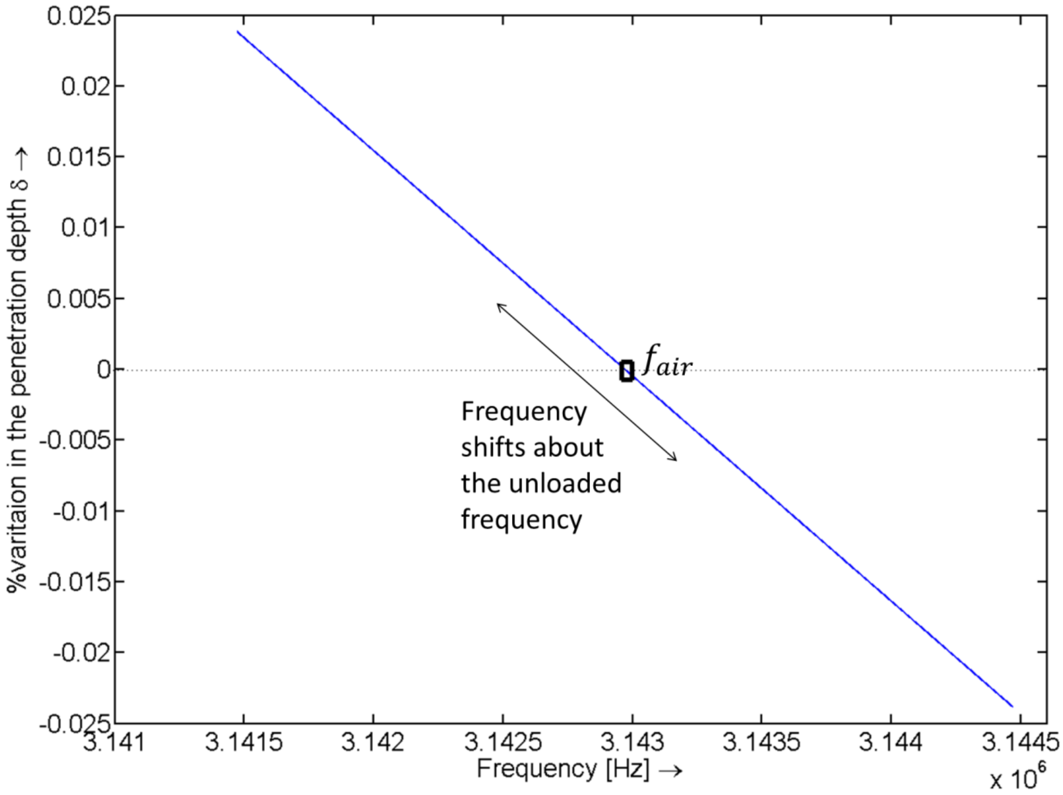
**Supplementary Material**

**A.1** Relationship between penetration depth and resonance frequency




$$\frac{\delta_L - \delta_{air}}{\delta_{air}} * 100 = \left( \sqrt{\frac{f_{air}}{f_{air} + \delta f}} - 1 \right) * 100$$

For the given $f_{air} = 3142969\ Hz$, if we assume that the $\Delta f = \pm\ 1500\ Hz$, then the variation in the penetration depth $\delta_L\ (= 318.5\ nm)$ is within 0.025% and insignificant.

**A.2** Mass and volume calculations

$$\delta_L = penetration\ depth\ (constant)[m] = 0.32 * 10^{-6}$$
$$r_c = contact\ radius\ [m]$$
$$L = side - length\ of\ the\ resonator\ [m] = 1400 * 10^{-6}$$
$$r_s = radius\ of\ the\ spherical\ cap\ [m]$$
$$V_c = volume\ of\ the\ thin\ shear\ layer\ of\ liquid\ [m^3]$$
$$Vs = volume\ of\ the\ sperical\ cap\ (droplet)[m^3]$$
$$m_c = mass\ of\ the\ thin\ liquid\ layer\ [kg]$$
$$m_s = mass\ of\ the\ droplet\ [kg]$$
$$H = height\ of\ the\ droplet\ [m]$$
$$d_L = desnity\ of\ water\ [kgm^{-3}] = 1000$$
$$\theta = contact\ angle\ [deg] = 48.85°$$

For a spherical cap geometry:

$$r_S = \frac{r_c}{\sin\theta}$$
$$V_c = \pi r_c^2 \delta_L$$
$$m_c = V_c d_L$$
$$H = r_s(1 - \cos\theta)$$
$$V_S = \frac{\pi}{6} H\left(3r_c^2 + H^2\right)$$
$$m_s = V_s d_L$$

Case 1: Maximum contact radius

$$r_c = \frac{L}{2} = 700 * 10^{-6}[m]$$

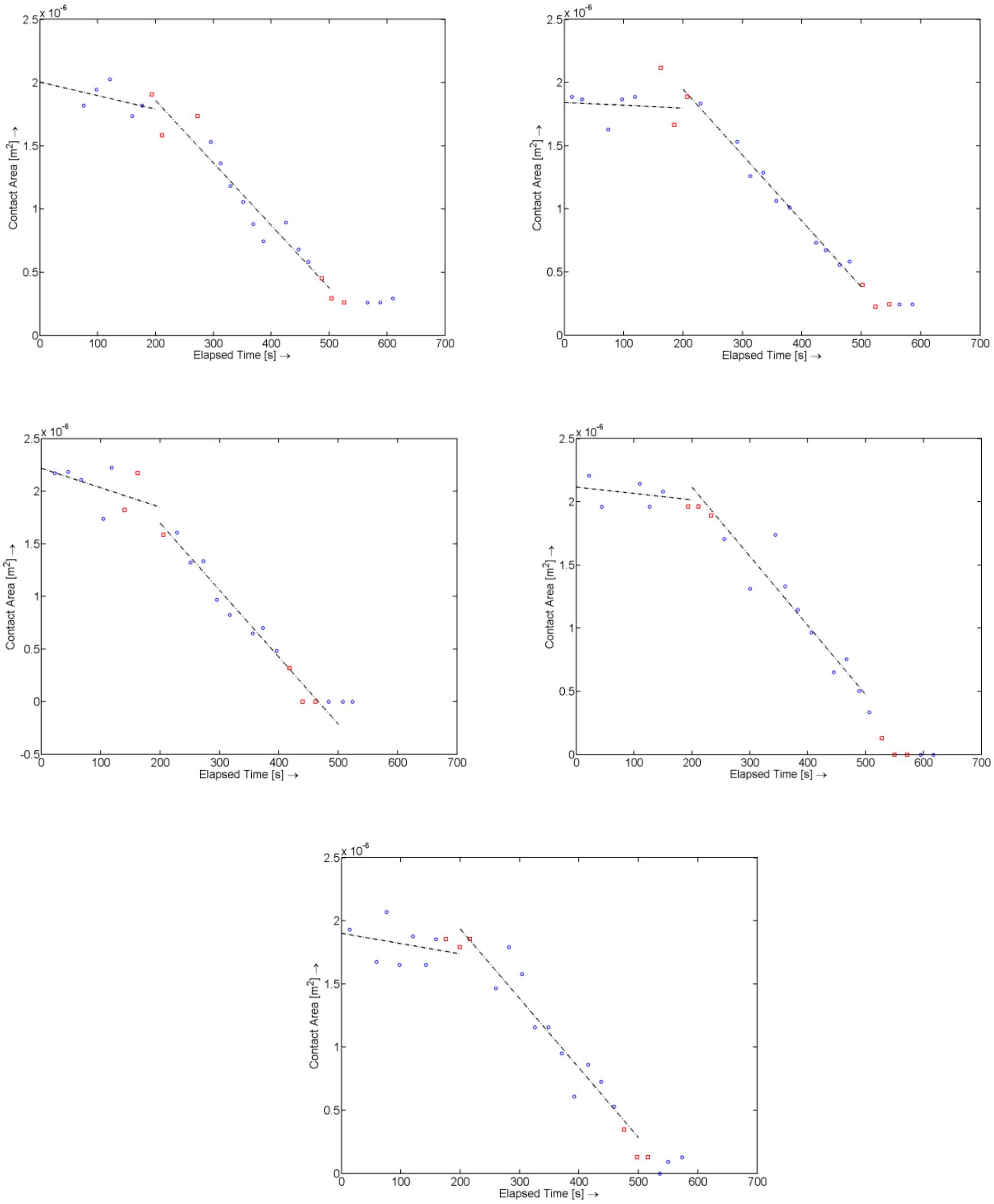
$$V_c = 4.92 * 10^{-13}[m^3]\ or\ 0.492\ nL,\ m_c = 4.92 * 10^{-10}[kg]\ or\ 492\ ng$$
$$r_s = 929 * 10^{-6}, H = 318 * 10^{-6}, V_s = 4.48 * 10^{-10}[m^3] or\ 448\ nL,\ m_s = 4.48 * 10^{-7}[kg] or\ 448\ \mu g$$

Case 2: Minimum observed radius from the microscope

$$r_c = 250 * 10^{-6}$$

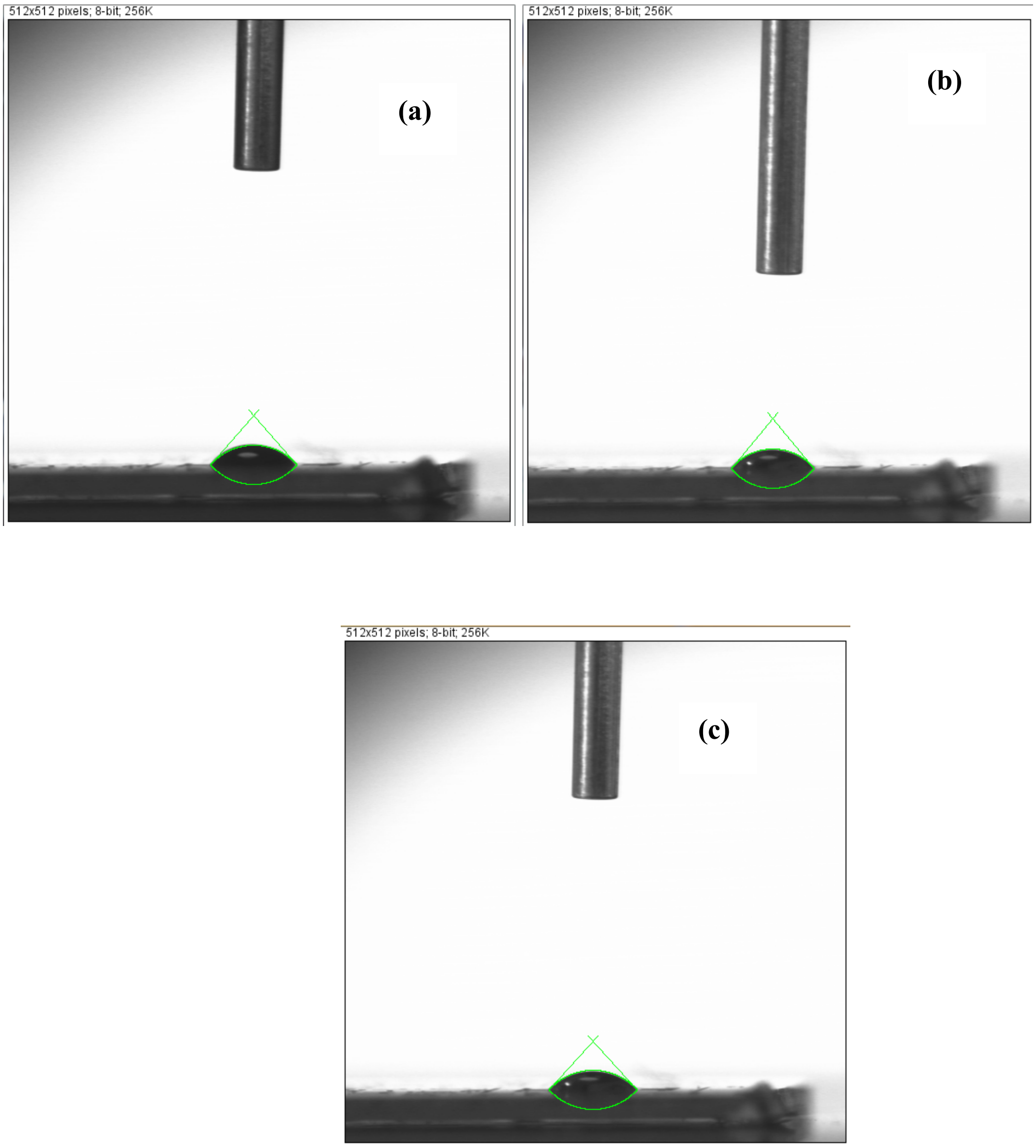
$$V_c = 6.28 * 10^{-14}[m^3]\ or\ 0.062\ nL,\ m_c = 6.28 * 10^{-11}[kg]\ or\ 62.8\ ng$$
$$r_s = 332 * 10^{-6}, H = 113.5 * 10^{-6}, V_s = 2.04 * 10^{-11}[m^3] or\ 20.4\ nL,\ m_s = 2.04 * 10^{-8}[kg] or\ 20.4\ \mu g$$

**A.3** Individual fitting of contact area plots




While linear fitting, transition points/corner points (red squares) are ignored

**A.4** Contact angle measurements



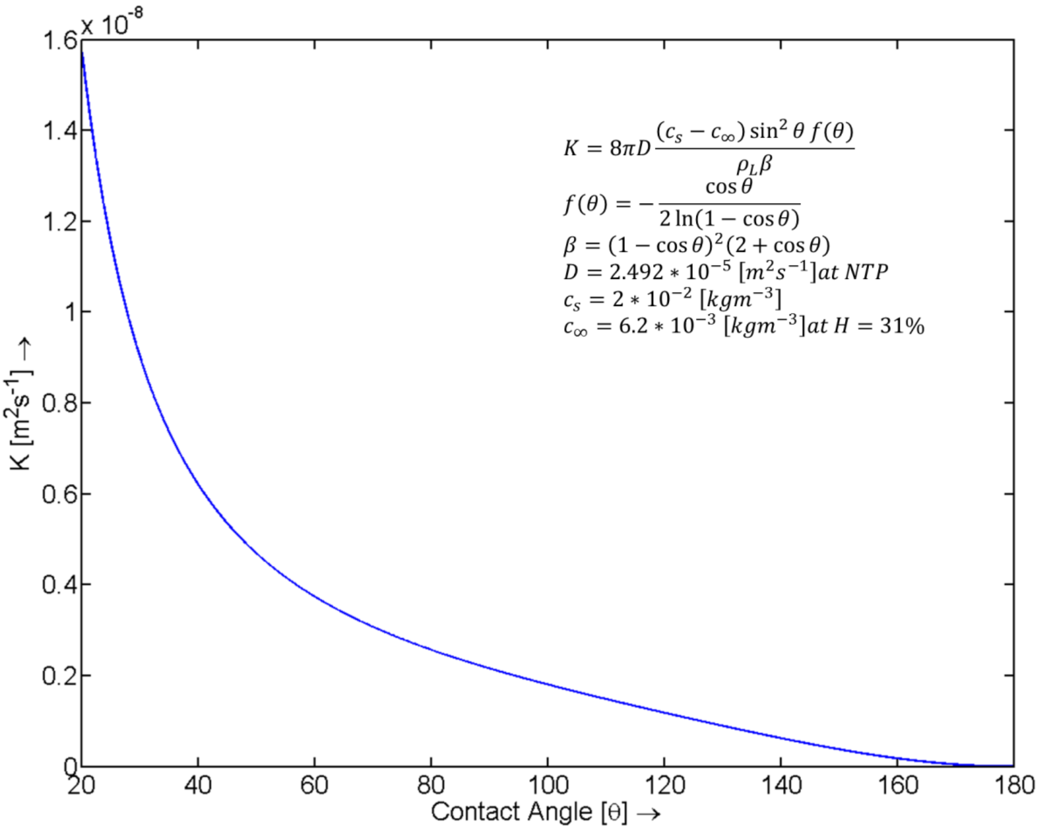

To determine receding contact angles for the device, CAM200 (KSV NIMA) Goniometer instrument was used. To extract CA values from the images, 'drop_analysis'[1] ImageJ plug-in was used. Low-bond Axisymmetric Drop shape analysis (LBADSA) option was used which involves optimizing the shape of the fitting spherical cap (green) so that it completely encloses the droplet.

$$CA_{avg} = \frac{CA_a + CA_b + CA_c}{3}$$

$$CA_{avg} = \frac{48.232° + 50.52° + 47.811°}{3} = 48.854°$$

**A.5** Relationship of K vs. contact angle

[1] http://mmrc.caltech.edu/Gniometeer/drop_analysis/drop_analysis.pdf




As the CA decreases (more hydrophilic), value of K increases rapidly. From the figure, it is clear that this rate is relatively smaller for hydrophobic cases.