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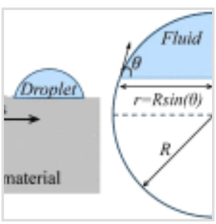

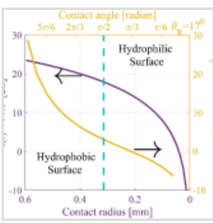

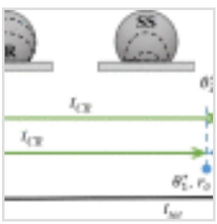

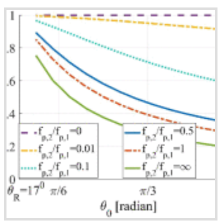

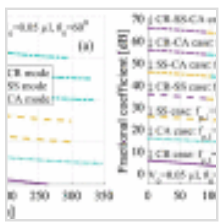

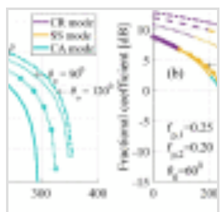

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Full Length Article

Effect of droplet shrinking on surface acoustic wave response in microfluidic applications

ThuHang Bui [a, b], Van Nguyen [c], Sten Vollebregt [a], Bruno Morana [a], Henk van Zeijl [a], Trinh Chu Duc [b], Pasqualina M. Sarro [a]

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Highlights

- Both contact angle and radius of a micro-size droplet can influence the experiment of the surface acoustic wave-based microfluidic applications.
- The change in contact radius effects the attenuation more than that in contact angle, especially on hydrophilic and super-hydrophilic surfaces.
- For larger liquid volume, the mostly stable duration of the SAW response is due to the only longer shrinking duration of the contact angle.
- For the long-time actuation and manipulation in experiments, the effect of the evaporation phenomenon should be considerable.

Abstract

The effect of the contact angle and radius of a microsize droplet on the surface acoustic wave (SAW) response for microfluidic applications is reported. It is studied through the dynamic change of the droplet shape during the evaporation process. An aluminium nitride SAW device, operating at 125.7 MHz, is utilized to investigate the deformation of the droplet shape (contact angle and contact radius) caused by shrinking. The large cavity placed on the propagation path distorts the in-band SAW response one time at the centre frequency. The fractional coefficient of the SAW insertion loss, before and after dropping the liquid on the propagation path, is continuously recorded. The change in the fractional coefficient shows that the radiated acoustic kinetic energy depends on the contact area between the sessile micro-size droplet and the SAW device more than the contact angle of the droplet. Three droplet volumes have been considered, namely 0.05, 0.1 and 0.13 μl, and the electrical results show a better agreement with the theoretical data than the optical image data. The average duration of the fractional coefficient change for these cases is 420, 573 and 760 s, respectively. The effect of the hydrophobicity versus hydrophilicity of the contact surface on the duration of the fractional coefficient change is studied by coating the SAW with a silicon oxide or hexamethyldisilazane (HMDS) thin layer. For the same 0.05 μl sessile droplet on the hydrophobic surface, this duration is on average 110 s longer than that on the hydrophilic surface.

Keywords

Microfluidics; SAW devices; Piezoelectric; Acoustics
