Report on short research visit by Mr. Mubbashar Mehmood, PhD Scholar, Heriot Watt University, UK.

Title: **Experimental study of the coupling mechanism of kinetic and thermal impacts of Rayleigh SAW on micro droplets by using ZnO based piezoelectric devices.**

When a water microdroplet is placed on the path where surface acoustic waves (SAW) propogate, longitudinal waves enter inside the droplet and causes internal streaming. Along with streaming, temperature of the droplet also increases. To understand the mechanims of the heat transfer and the fluid flows, lab experiments were carried out in the University of Northumbria, Newcastle upon Tyne. The streaming was visualised by adding 10 μm red polystyrene particles, however, data was recorded by CCD video camera. Thermal impacts of SAW on the droplet was recorded by FLIR thermal camera.

Experiments and results outline; Following SAW devices were used to analyze streaming and temperature change inside droplet;

i. ZnO thin film (thickness 5 um) coated Si substrate
ii. ZnO thin film coated Al foil (thickness 50 um) with variable designed wavelength
iii. ZnO thin film coated Al plate (different thicknesses and different wavelengths)

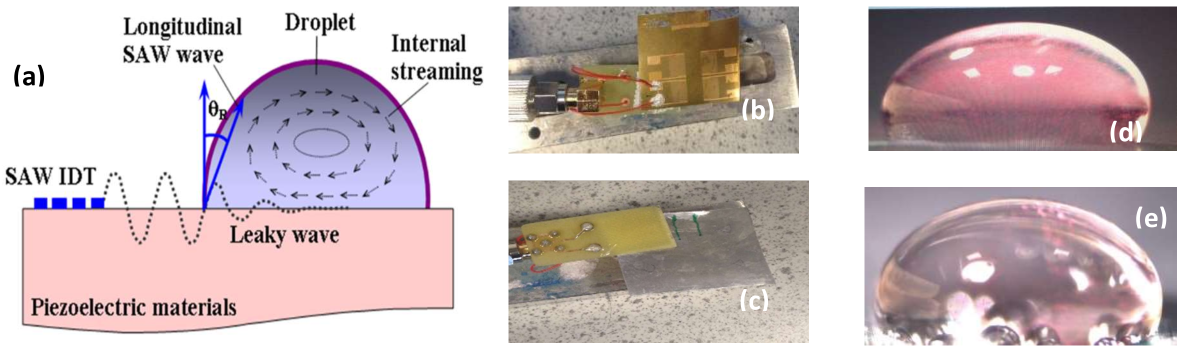

Fig. 1: SAW interaction with liquid droplet (a) Schematic diagram (b) ZnO on Al plate IDT from top side (c) IDT from back side (d) Streaming inside droplet at low power of 25 ul droplet (e) bubbles from substrate surface at high temperature (after 20.0 s of SAW power at +10.0 dBm, frequency 26.200 MHz, Rayleigh entering left side).

Both top and back side of the device were used to visualize streaming as shown in fig. 1-(b) and (c) respectively. At lower power, only streaming of particles observed but at higher power, it start making bubbles (fig. 1-(e))

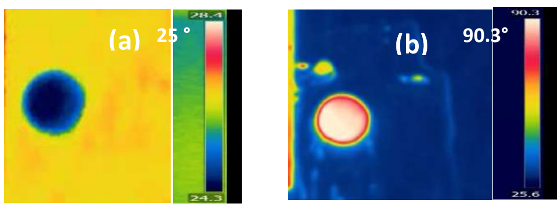

Fig. 2: Thermal image by FLIR camera (a) before giving SAW power temperature is nearly 25 ° (b) After 20.0 s of giving SAW from left side at +13.0 dBm, temperature of droplet becomes 90.30 ° (Device, frequency, wave mode and droplet size are similar as mentioned above).

Both back side and top side of devices were used to analyse thermal changes as well. Temperature change inside the droplet is shown in figure 2. Si based devices have more or less similar streaming and temperature on the top and back side, however Al-foil and Al-plate have higher temperature on back side than top. In comparison between foil and plate, plate have higher temperature than foil.

Analysing the data and writing journal paper is in process. However this will be interesting to extend this work to bending Al plates and inclined surfaces which may have different temperature and momentum of the droplet.

Hosted by: Prof. Richard Fu, Faculty of Engineering & Environment, University of Northumbria, Newcastle upon Tyne, UK.