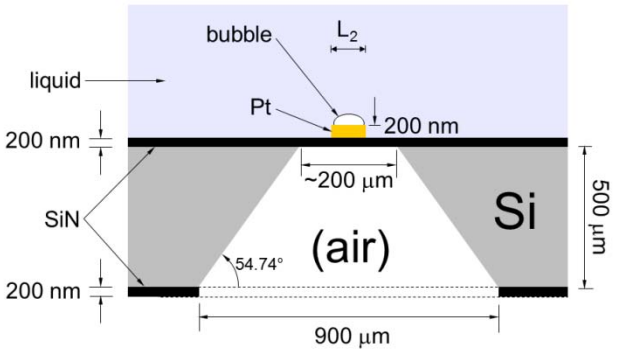
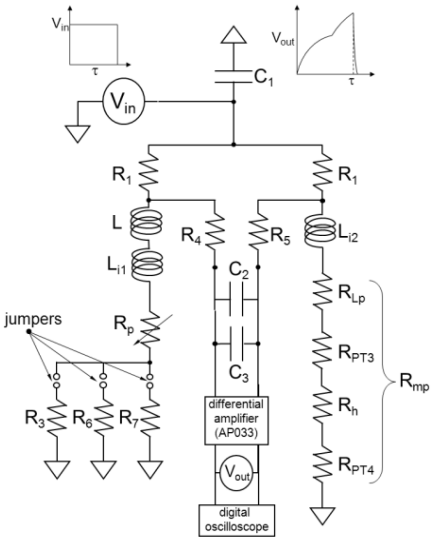
M.Eng Project
"Design of a More Energy Efficient Ink Jet Printer"

Some ink jet printers rely on bubble formation on microscale thin metal films to push ink through tiny nozzles aligned with the metal films to form ink droplets. The droplets are directed to paper to form print characters by programmed motion of the print head. Also called "bubble jet" printers, the concept relies on rapidly heating the print head to nucleate an ink bubble. This process takes energy, which can be a critical consideration in portable, battery-operated, printers. The conventional design is for the print heads to be fabricated onto solid substrates. In this project the configuration to be investigated is a structure fabricated across an air gap that provides an insulating effect to heat flow, shown in the schematic below. Significantly less energy is anticipated to be required for nucleating bubbles compared to configurations with a solid in place of the air (the typical configuration).





This project will concern using a sophisticated but easy-to-use experimental design to heat the metal films to temperatures well above their normal boiling points. The heaters are immersed in a liquid (e.g., water or an organic liquid) and heated very rapidly (upwards of a billion degrees per second) until a bubble forms. The instant of bubble formation will be captured by making the microscale thin film heater part of a "wheatstone bridge" (a schematic is shown) with suitable electrical filtering to produce a clear response signal that can ultimately be related to average metal film temperature.

Some familiarity with operating digital oscilloscopes, pulse generators and Labview would be helpful (though not necessary). The project is suitable foraM.Eng students.

related publication:

E.J. Ching, C.T. Avedisian, M.J. Carrier, R.C. Cavicchi, J.R. Young, B.R. Land, "Bubble Nucleation of Highly Superheated Water on Back-side Etched Thin Film Platinum Membranes using a Low-Noise Bridge Circuit," Int. J. Heat Mass Transf., 79, 82-93 (2014).

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