# Microscale Cavitation with Energy Applications


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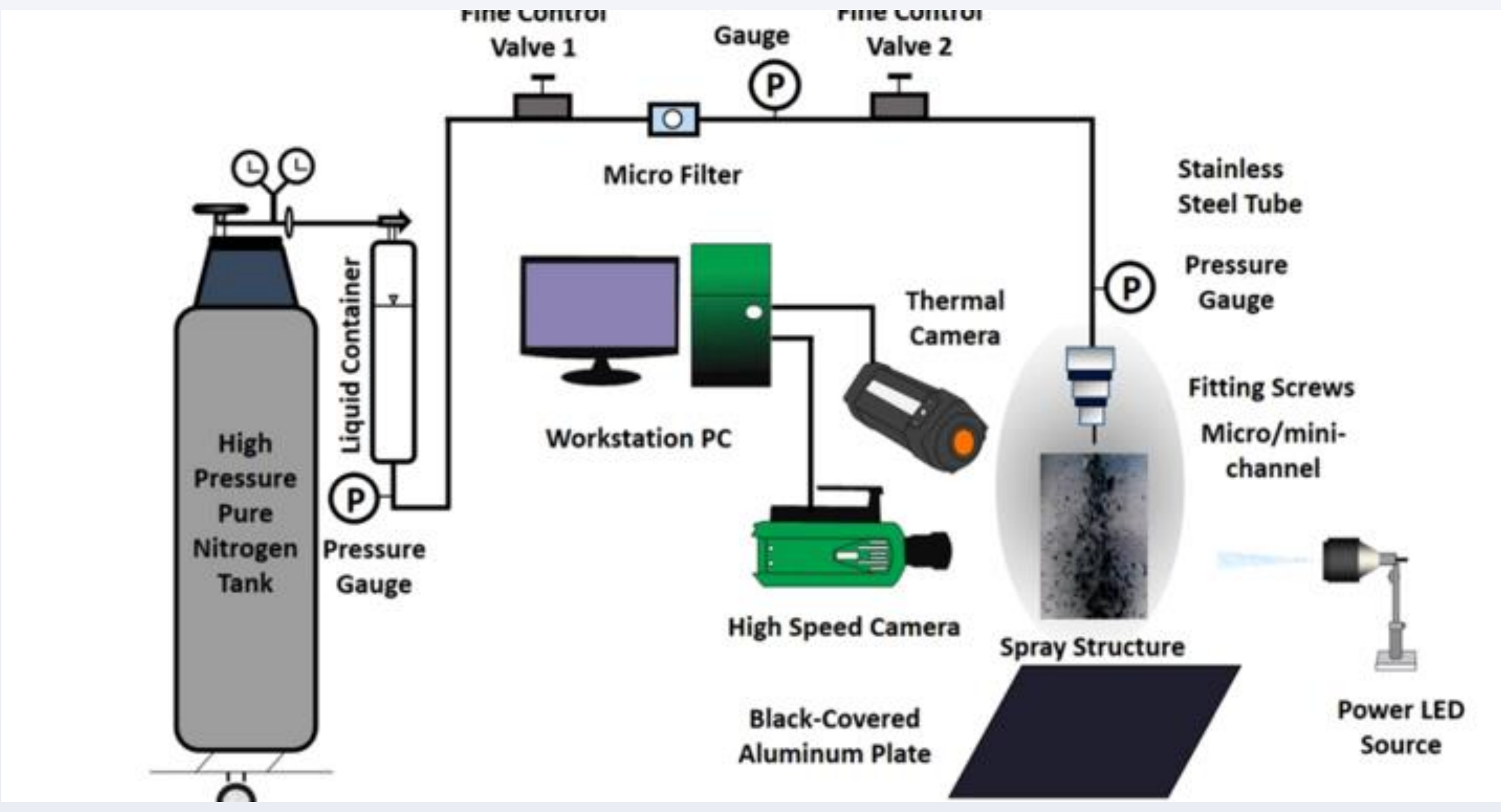
PURE
PROGRAM FOR UNDERGRADUATE RESEARCH

## SUMMARY

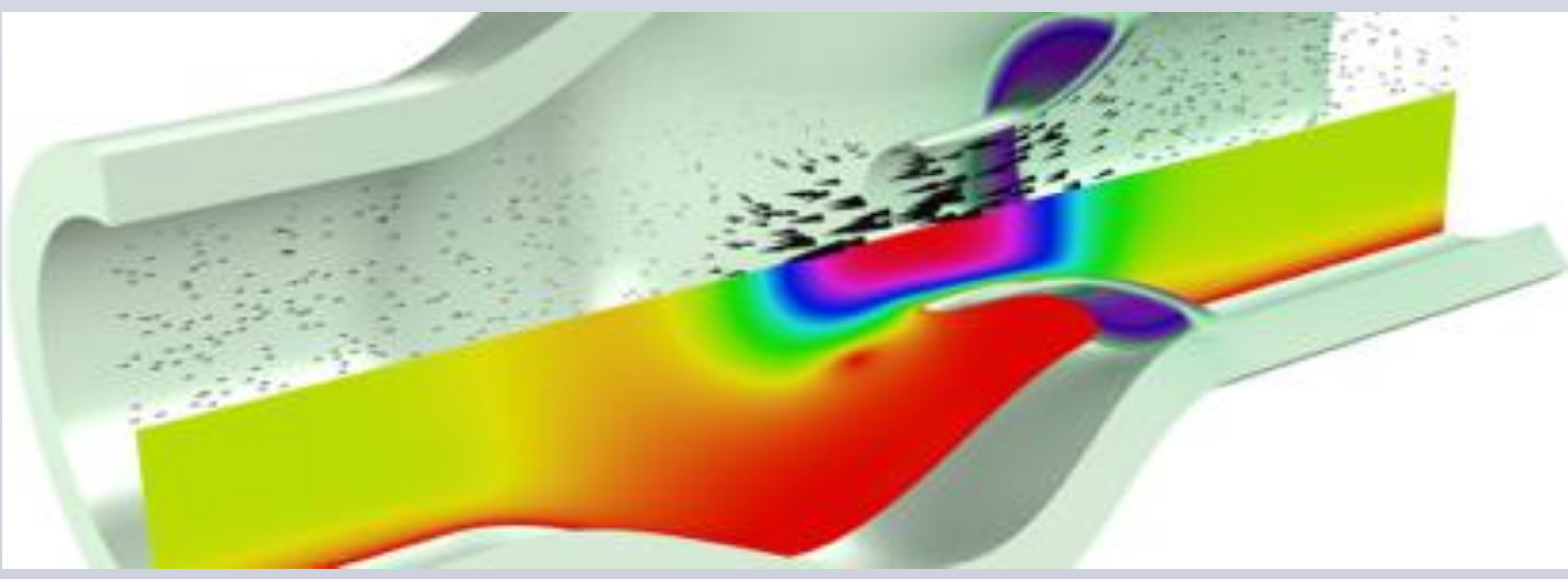




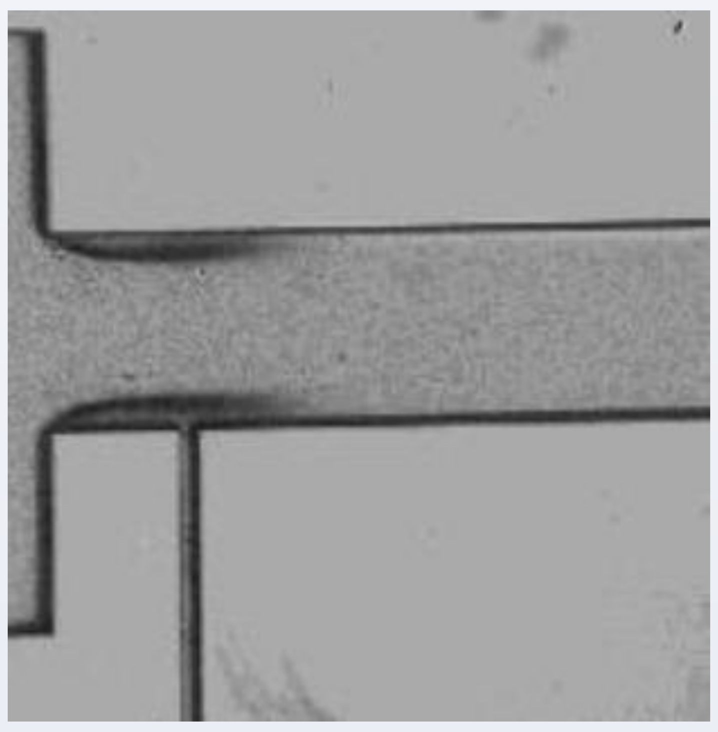
Cavitation is the formation of vapor phase cavities or bubbles in liquids which are generally formed because of rapid changes in localized pressure. Cavitaton used as an energy means in this project. With the help of cavitating flows from microchannel configurations of different sizes, there emerges a heat energy at the surface of the thin place. The aim of this project finding the highest of that energy with the most efficient values of parameters. So it is a particular interest to study the conditions under which cavitation formation is optimal. Some parameters were determined to reach these values since preliminary results have proved that wall roughening and the diameter in microchips affects the initial flow. Effects of these values in nozzle and latest flows are observed also in separate chips. Flow patterns are visualised using high-speed visualization systems to obtain data.


## METHODS AND OBJECTIVES

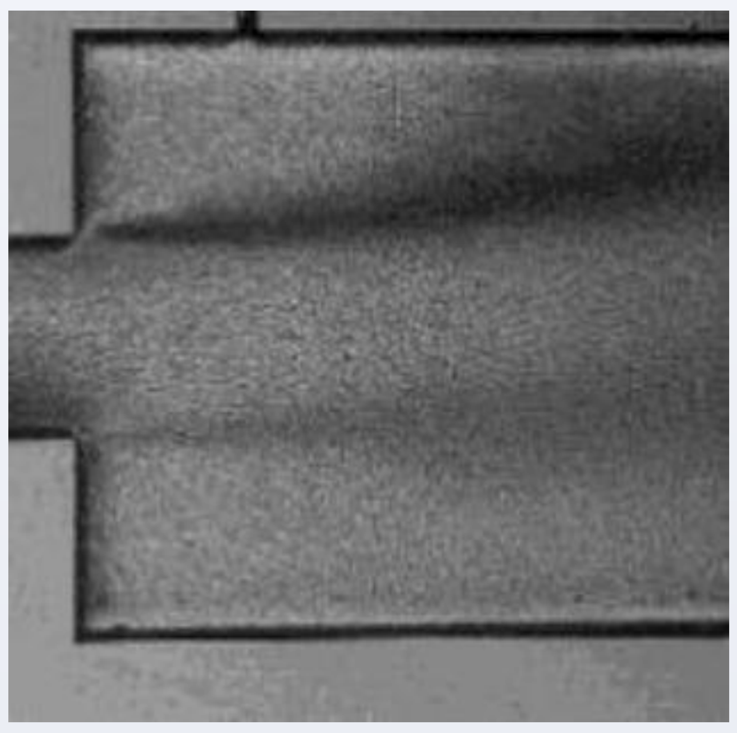
The chip with the micro channel which the water flows through consists of two layers: a glass and a silicon layer. There are three places through the channel that are connected to a pressure gauge via a device called the sandwich which holds the chip. There are two tanks connected to the device. First one is the nitrogen tank which generate the pressure formation and is connected to the water tank. The water flows through some pipes and there is also another pressure gauge in between the device and the pipes. Another important part of the setting is the high speed camera and a light source to visualise what is happening inside the chip. In order to record when the cavitation begins, at what pressure and where (at the nozzle or at the extension) visualisation is a crucial step. The upstream pressures that are recorded goes like 150-300-450-600-750-900-1050 PSI. The pressures inside the chip is recorded as P1, being the first pressure before water enters the nozzle; P2, being the pressure inside the micro channel and P3 pressure at the extension which is usually read as 0.



## RESULTS AND CONCLUSION

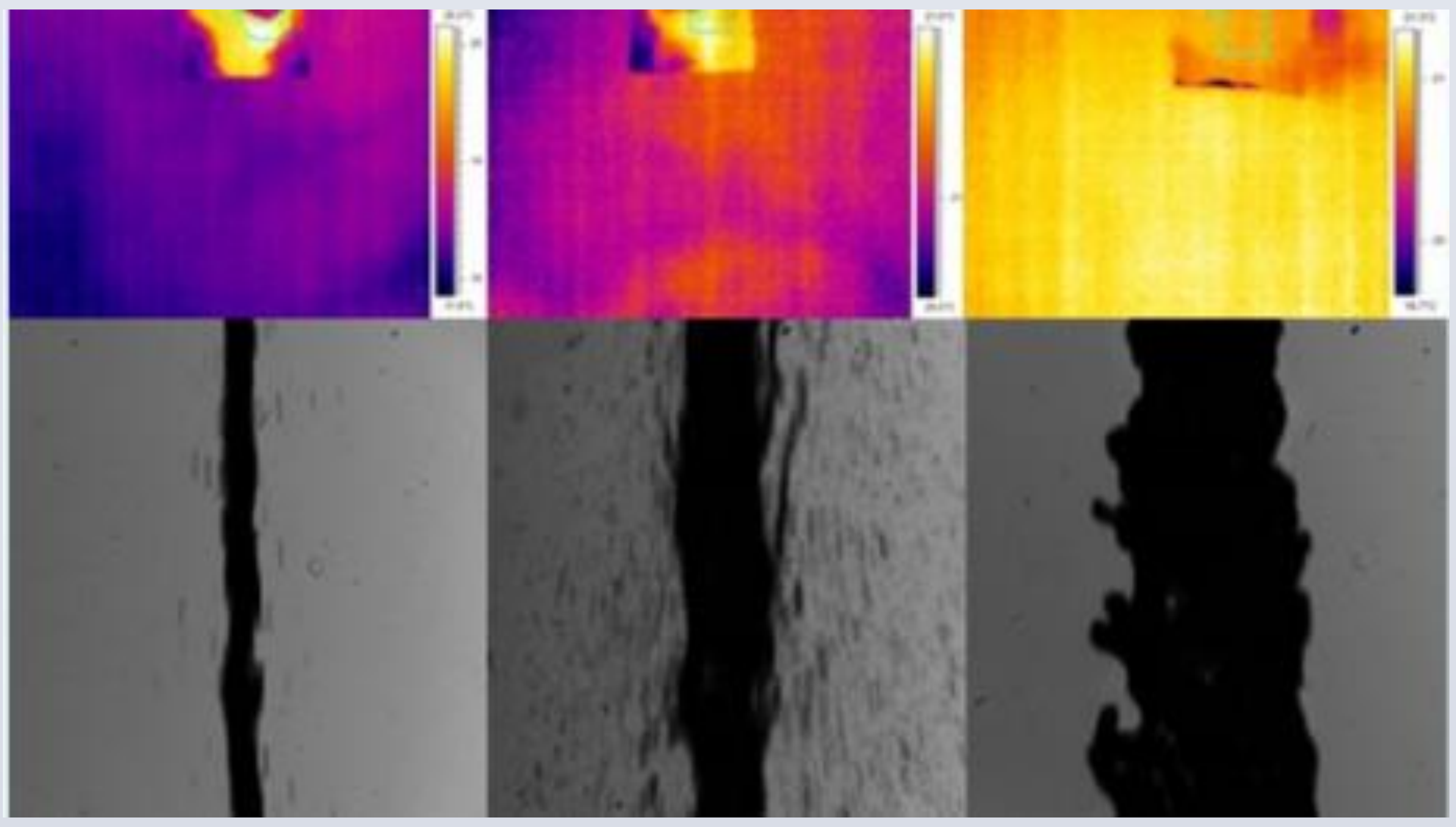


Flow at initiation



Progressed flow

According to the results of this study, cavitation occurs due to geometric variables in the microchips produced and thermo-physical conditions. It has been observed that surface roughness has great importance for the initiation and progression of the cavitation flow. As the roughness increases, this progression increases sharply. The thermal gradients in the surface are affected by the solid interactions of the bubbles that formed by the cavitation. This process leads to the formation of a heat energy. A more efficient cavitation flow was observed when the difference between p1 and p2 was high. For the targeted result, experiments are focused on the chips that will provide this difference.



Energy harvesting from thermal energy

## CONCLUSION GOAL

Main aim of this project is finding a cost effective and environment friendly solution to energy searching with optimized roughed microchips. Its energy can be used as a power resource for miniature consumer devices.

## REFERENCES


Ghorbani, M., Mohammadi, A., Motezakker, A. R., Villanueva, L. G., Leblebici, Y., & Koşar, A. (2017). Energy Harvesting in Microscale with Cavitating Flows. *ACS Omega*,*2*(10), 6870-6877. doi:10.1021/acsomega.7b01204