Effect of surface modification on pool boiling heat transfer

Pool boiling (boiling occurring in a close and stagnant system) is a really efficient mechanism of heat transfer. Heat fluxes as high as 100 W/cm^2 can be removed while keeping the heating surface under reasonable temperature. Due to his effectiveness it is used in several cooling application such as electronic cooling.

In this context part of the work performed addressed the design and development of a bench mark facility based on a two-phase closed loop thermo syphon. This study aims at demonstrating the feasibility of pool boiling of dielectric fluids to be used as a CPU cooling technique.

In order to increase the cooling performance of the aforementioned technique, the use of micro-structured surfaces, whose micro-patterns consisted of arrays of laser etched cavities, was investigated. The results showed an increase in cooling performance when using micro structured surfaces, when compared to a smooth surface.

Surface modification could also involve change in wettability of the surface. A more fundamental part of the work focused on the detailed description of the heat transfer and bubble dynamics processes occurring for the boiling of water over surfaces with extreme wetting regimes, namely hydrophilicity and superhydrophobicity.

The investigation performed, allowed a more adequate description of bubble dynamics and to identify the most adequate parameters relating these dynamic processes with surface wettability. The results showed a particular trend of the boiling curve obtained for the superhydrophobic surfaces, which is in line with the recently reported in the literature.