Cavitation erosion in liquid nitrogen

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Long Abstract

Introduction

Thermodynamic effects in cavitation become significant only when the critical-point temperature is close to the operating temperature of the fluid, as in the case of cryogenic fluids. Therefore, the understanding and the prediction of the cavitation effects in such cases is crucial in many applications - for example the turbopumps for liquid hydrogen (LH2) and oxygen (LOX) in space launcher engines. The new generation of rocket engines will also feature the possibility of re-ignition while in orbit and prolonged period of operation; hence cavitation erosion is becoming an issue at the design stage of the turbo-pumps.

1. Methods

In the study, we show measurements of cavitation erosion in liquid nitrogen (LN2), where cavitation was generated by an ultrasonic transducer. The damage was evaluated on aluminum samples. Special are was given to accurate setting of the operation point – especially the operating pressure, which defines the cavitation extent. We show that it is less aggressive than cavitation I water and that its aggressiveness cannot be described by a single fluid property (for example Brennen's thermodynamic parameter Σ). We also compared performance of several other engineering materials. Finally, we employed a bubble dynamics model with consideration of the thermodynamic effect to qualitatively predict the results of the measurements.

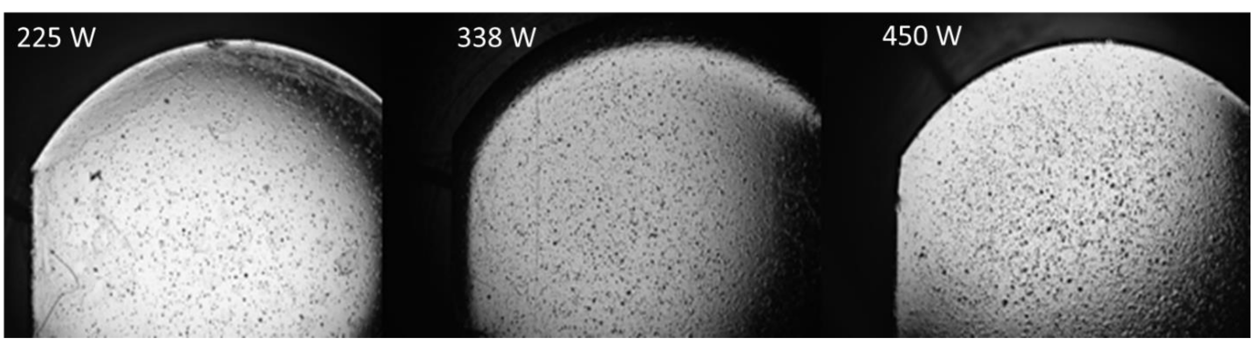

Figure 1. Damage to the specimen at different powers and the same cavitation number (σ=9)