Characterization of Cavitation in Ultrasonic or Megasonic Irradiated Gas Saturated Solutions Using a Hydrophone

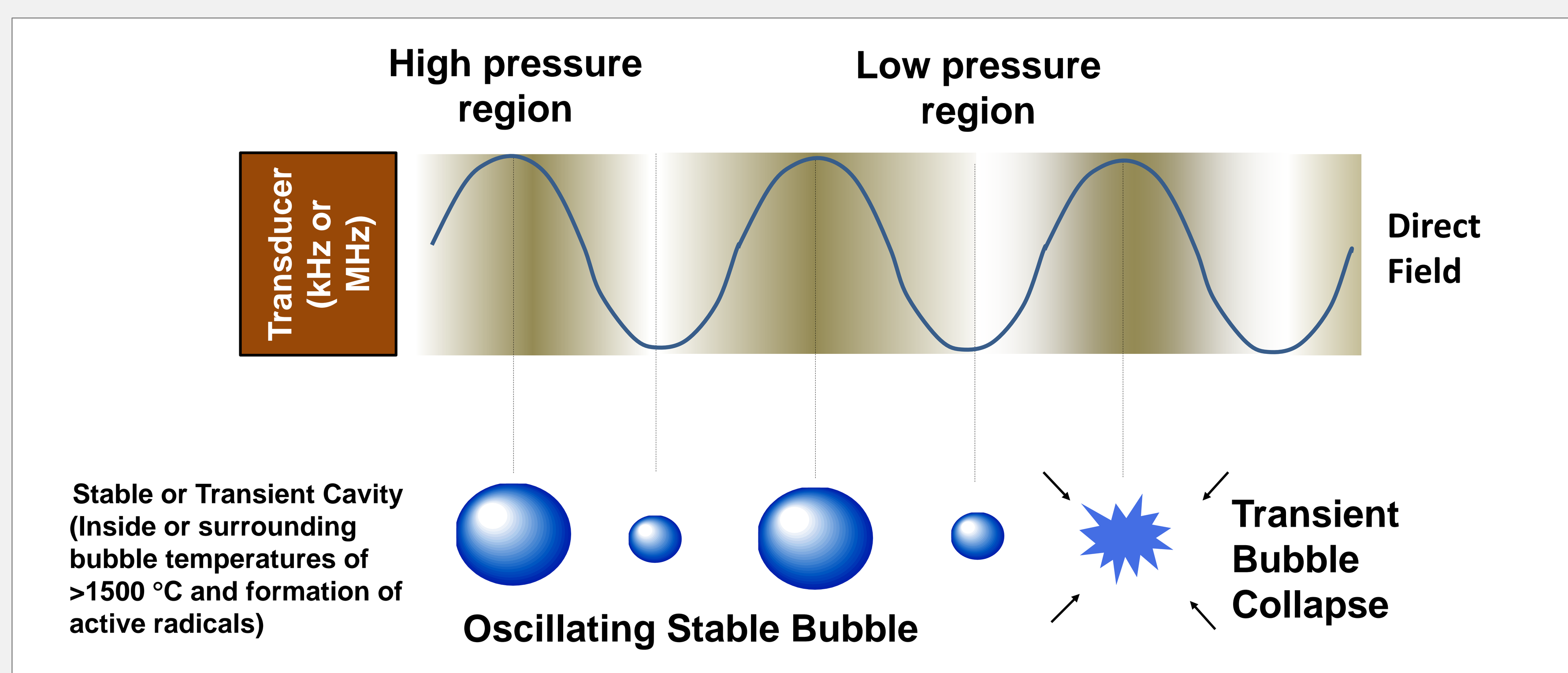
M. Zhao [1], R. Balachandran [2], P. R. Madigappu [2], P. Yam [3], C. Zanelli [3], R. Sierra [1] and M. Keswani [2, a]

[1] Department of Chemical and Environmental Engineering, University of Arizona, 1133 E James E. Rogers Way, Tucson, AZ, USA
[2] Department of Materials Science and Engineering, University of Arizona, 1235 E James E. Rogers Way, Tucson, AZ, USA
[3] Onda Corporation, 1290 Hammerwood Ave., Sunnyvale, CA, USA
[a] manishk@email.arizona.edu

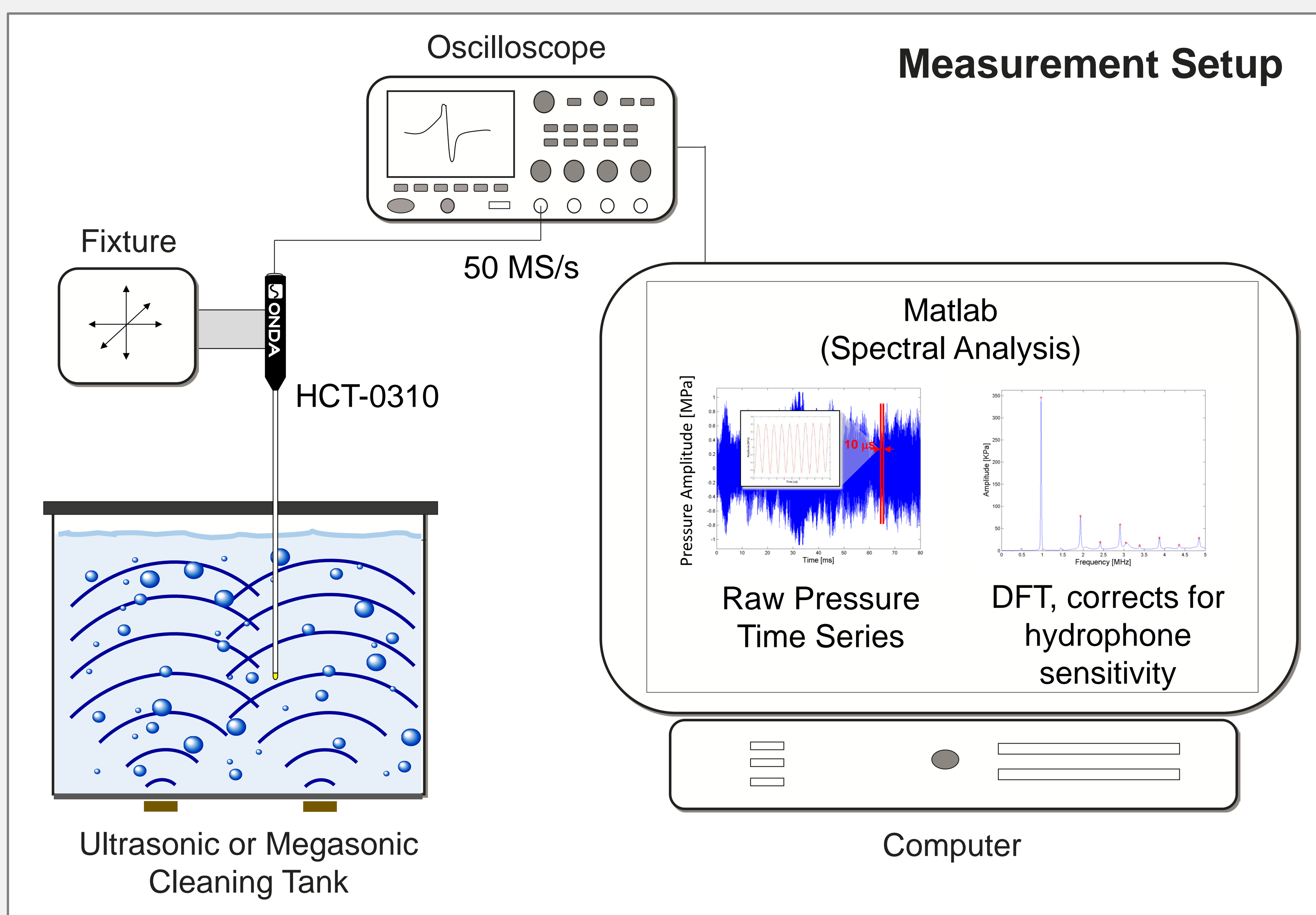
INTRODUCTION

The advancement of ultrasonic and megasonic cleaning processes for applications (semiconductor, masks, storage devices, solar cells, etc.) drive the need to characterize the acoustic performance under different process conditions.

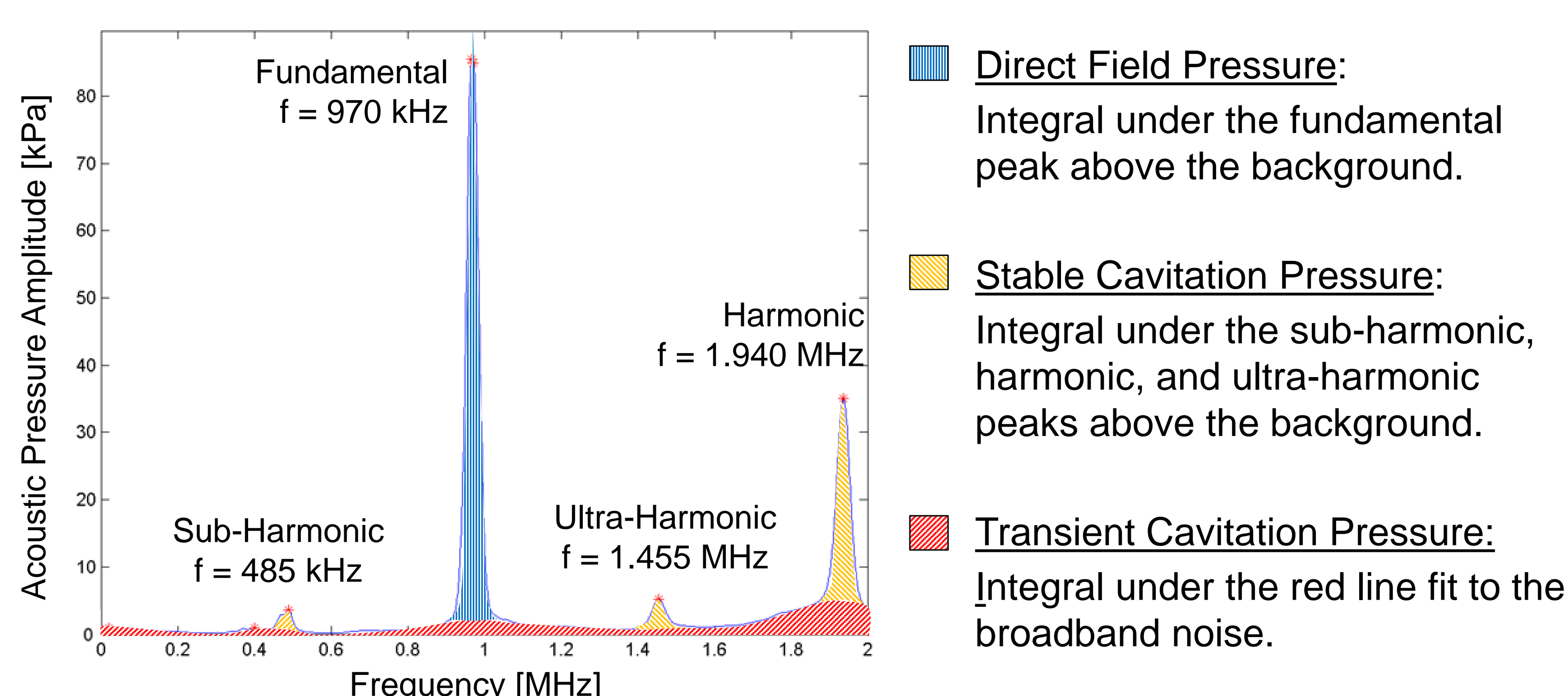
Spectral analysis was performed on pressure-time data acquired using a hydrophone to quantify the level of stable and transient cavitation pressure field relative to the direct pressure field. Measurements were conducted to investigate the effect of different dissolved gases (air, argon and CO_2) and non-ionic surfactants (Triton \X-100 and NCW-1002) on cavitation at varying power densities and acoustic frequencies between 25 kHz and 970 kHz.



METHODS

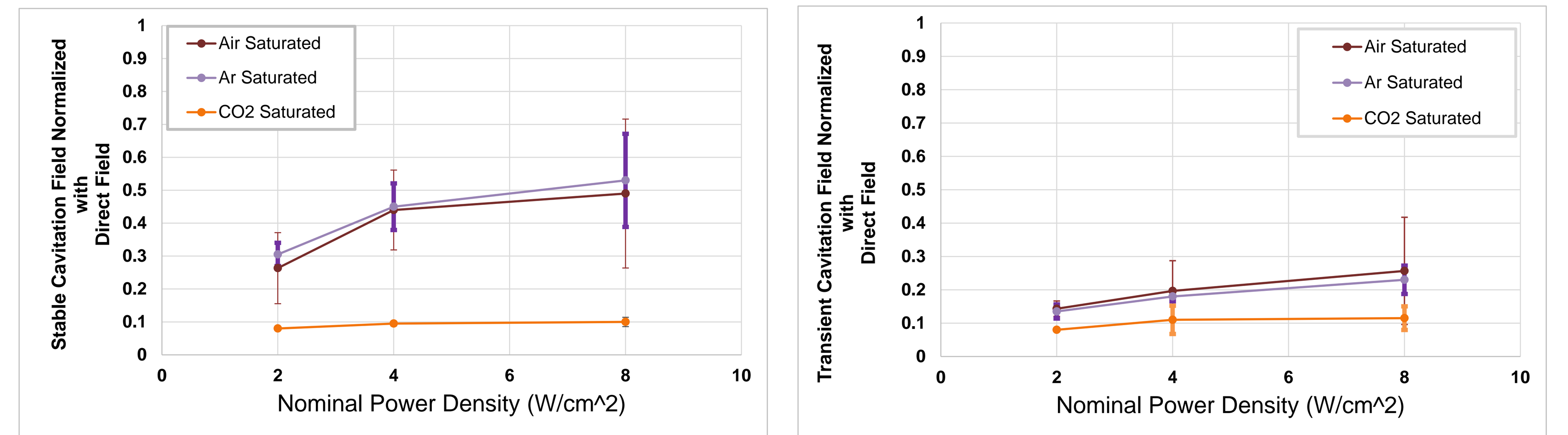


Sample 970 kHz Spectrum



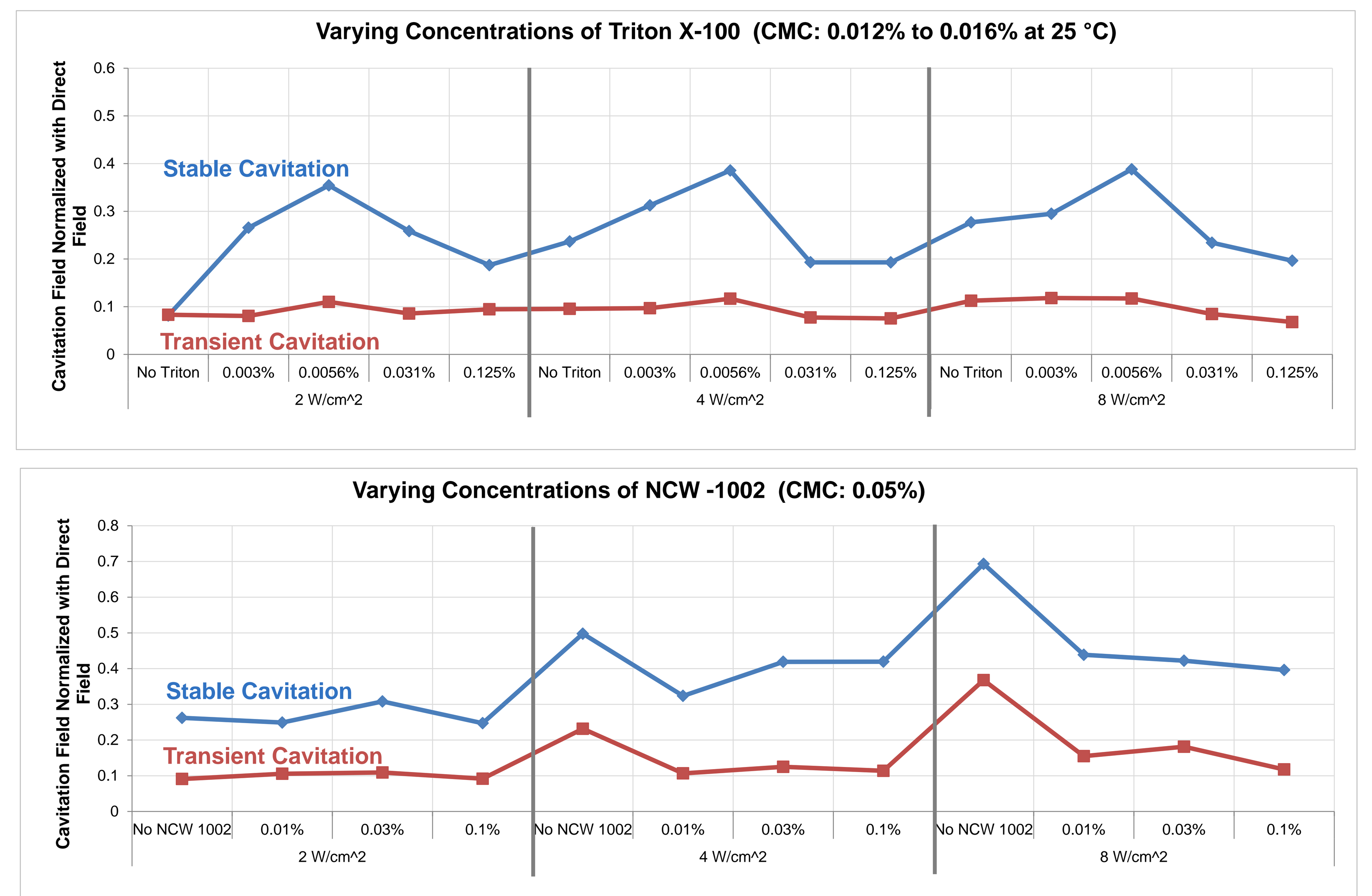
RESULTS & DISCUSSION

Dissolved Gases



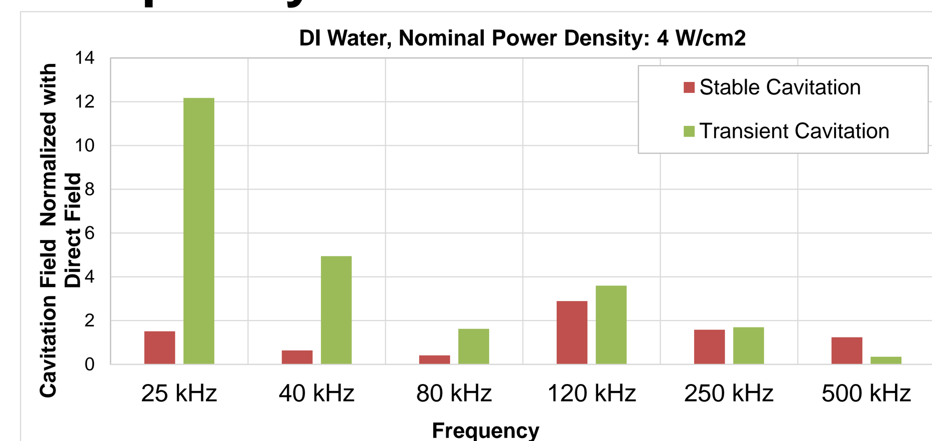
The normalized stable and transient cavitation pressure field increases with transducer power density for solutions saturated with air or argon while it remains almost constant for CO_2 saturated solutions

Surfactant Concentration



Addition of a non-ionic surfactant at concentrations above CMC reduces the extent of both stable and transient cavitation especially at higher power densities of 4 and 8 W/cm^2.

Frequency



Extent of transient cavitation decreases as frequency increases from 25 to 500 kHz; No clear correlation between stable cavitation and frequency in the range investigated.

CONCLUSIONS

With the use of hydrophones, spectral analysis can be performed to quantify the level of stable and transient cavitation under various process conditions. This methodology can be particularly useful to develop, optimize, and control advanced ultrasonic and megasonic cleaning processes for semiconductor applications.

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