Acoustic vaporization threshold of lipid coated perfluoropentane droplets

M. Aliabouzar, K. Kumar, K. Sarkar

The George Washington University
Department of Mechanical and Aerospace Engineering

**Motivation**

Ultrasound imaging is non-invasive, real-time, inexpensive, but it suffers from low contrast.

**Objectives**

- Synthesis and design of phase shift nanodroplets for extravascular interrogations.
- Experimental methodology to determine vaporization threshold of phase shift nanodroplets.
- Comparison of their acoustic responses with conventional ultrasound contrast agents.

**Materials and methods**

- **Droplet Preparation**
  - Lipid solution
  - Perfluoropentane (PFP)
  - Sonication
  - Droplets

**Acoustic droplet vaporization setup**

- Transmitting transducer
- Receiving transducer
- Syringe pump injecting the droplet suspension
- Transducers passing through the focal volume

**Criterion for ADV threshold determination**

- Droplets (before vaporization) — respond weakly to ultrasound.
- Droplets (after vaporization) — strong scatterers of ultrasound, strong nonlinear components.

**Results**

- Sudden jump in acoustic responses → Vaporization threshold

**Scattered responses from microbubbles and vaporized droplets**

**Excitation frequency of 2.25 MHz**

- Acoustic droplet vaporization, images (b) & (c), captured by ultrafast cameras.

**Conclusions**

- ADV threshold increases with frequency and decreases with temperature.
- The mechanical index at each frequency is lower than 1.9, which is recommended by FDA.
- The scattered response from vaporized droplets matches well with that of independently prepared lipid-coated microbubbles in magnitude as well as trends above the threshold.

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**Supplementary information**

- Table: Frequency (MHz) MI C 37°C
  - 2.25 0.7 0.43
  - 5 0.84 0.38
  - 10 0.74 0.45

**References**

1. www.iame.com