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Rheological Properties, Shape Oscillations and Coalescence of Liquid Drops with Surfactants

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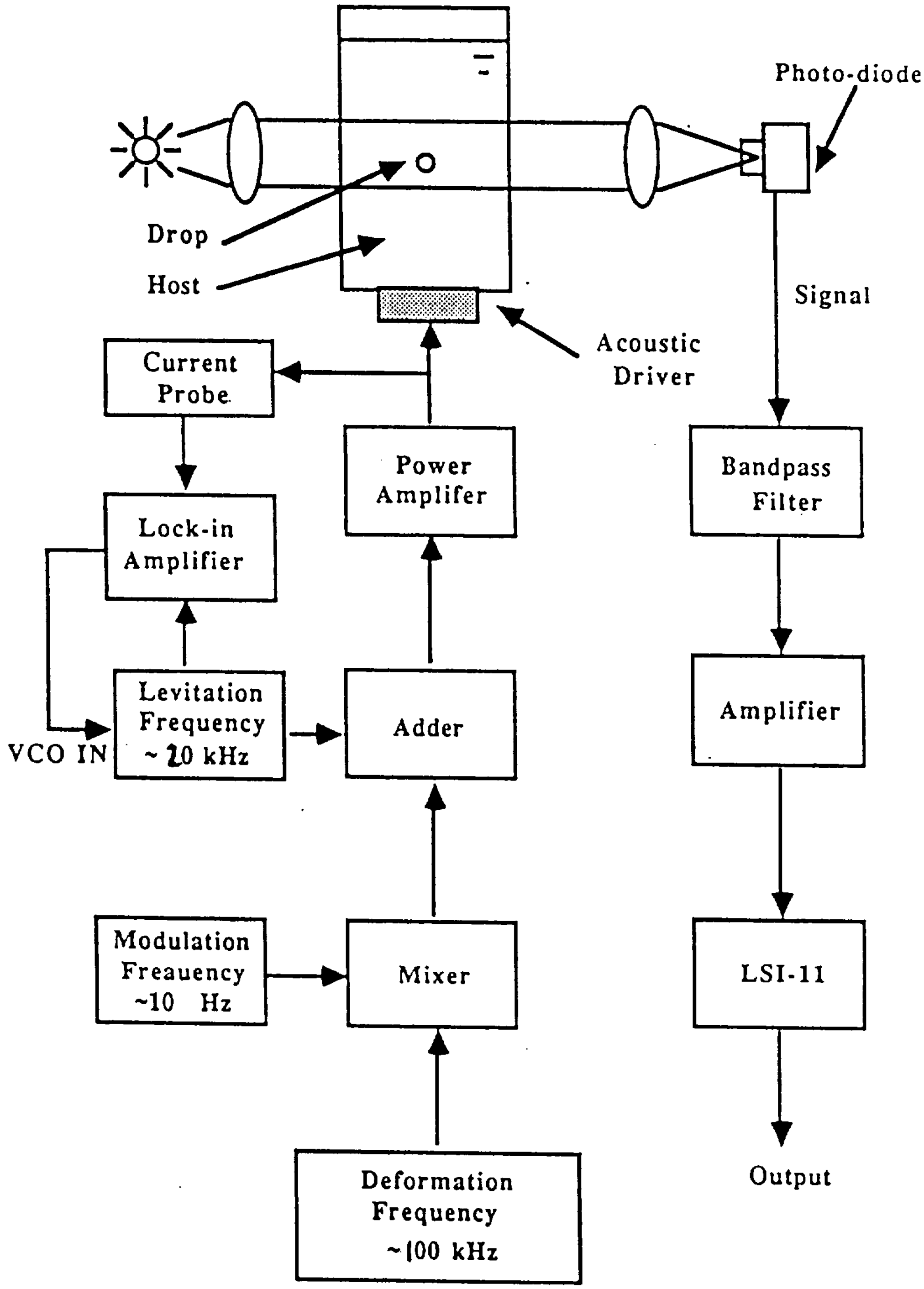
A method has bee developed to deduce dynamic interfacial properties of liquid drops. The method involves measuring the frequency and damping of free quadrupole oscillations of an acoustically levitated drop. Experimental results for pure liquid-liquid systems agree well with theoretical predictions. Additionally, the effects of surfactants is considered. Extension of these results to a proposed microgravity experiment on the DPM in USML-1 will be discussed.

Efforts are also underway to model the time history of the thickness of the fluid layer between two pre-coalescence drops, and to measure the film thickness experimentally. Preliminary results will be reported, along with plans for coalescence experiments proposed for USML-1.



Schematic diagram of the experimental setup.

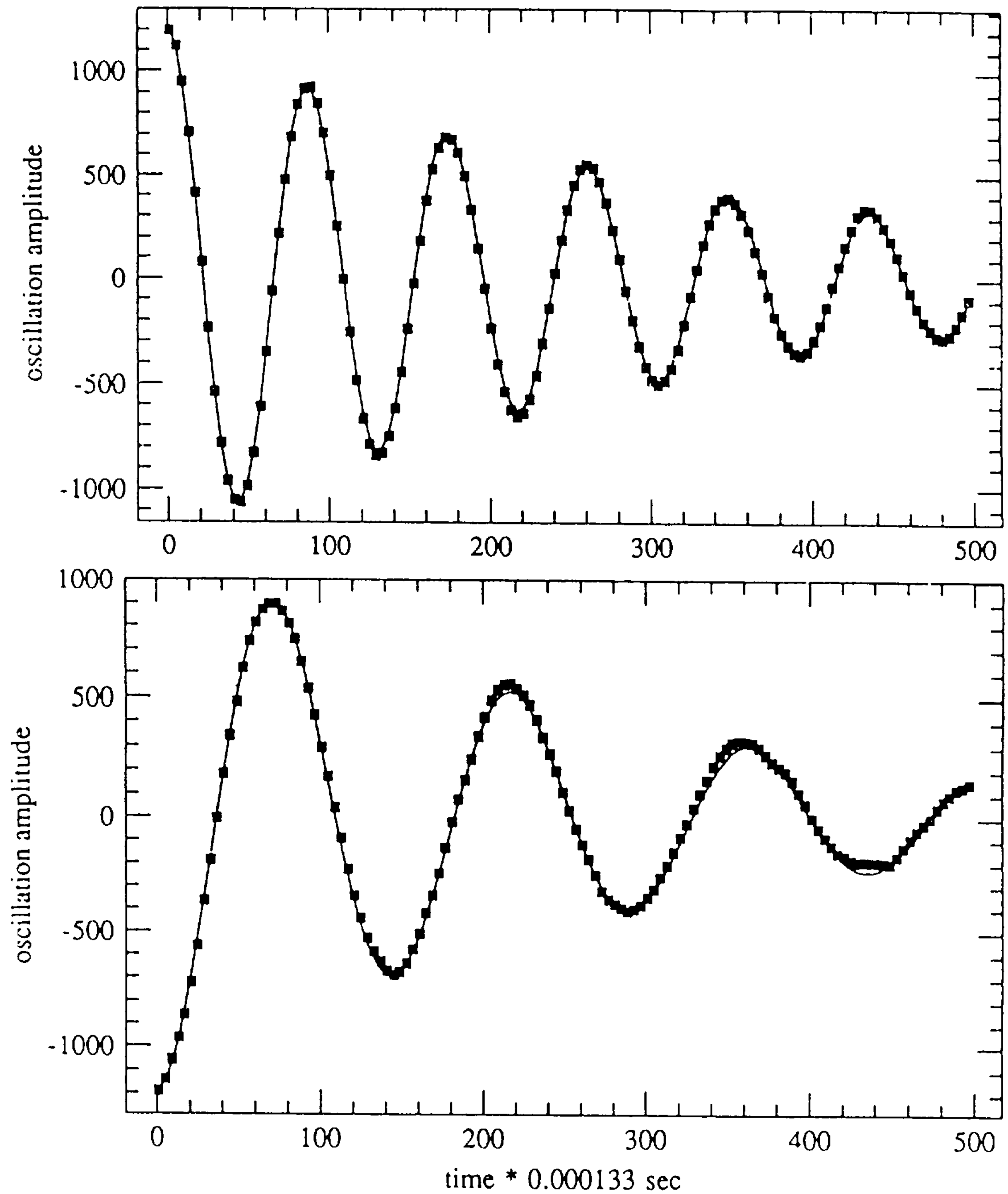


Fig. 2 Signals for a drop undergoing free quadrupole oscillations before and after least squares fitting. For the purpose of clarity, only one fourth of the measured data points are shown in each figure. The upper figure is for a hexane drop of a diameter 0.2002 cm in pure water. The lower figure is for a hexane drop of a diameter 0.1954 cm in 1.75 mM SDS aqueous solution.

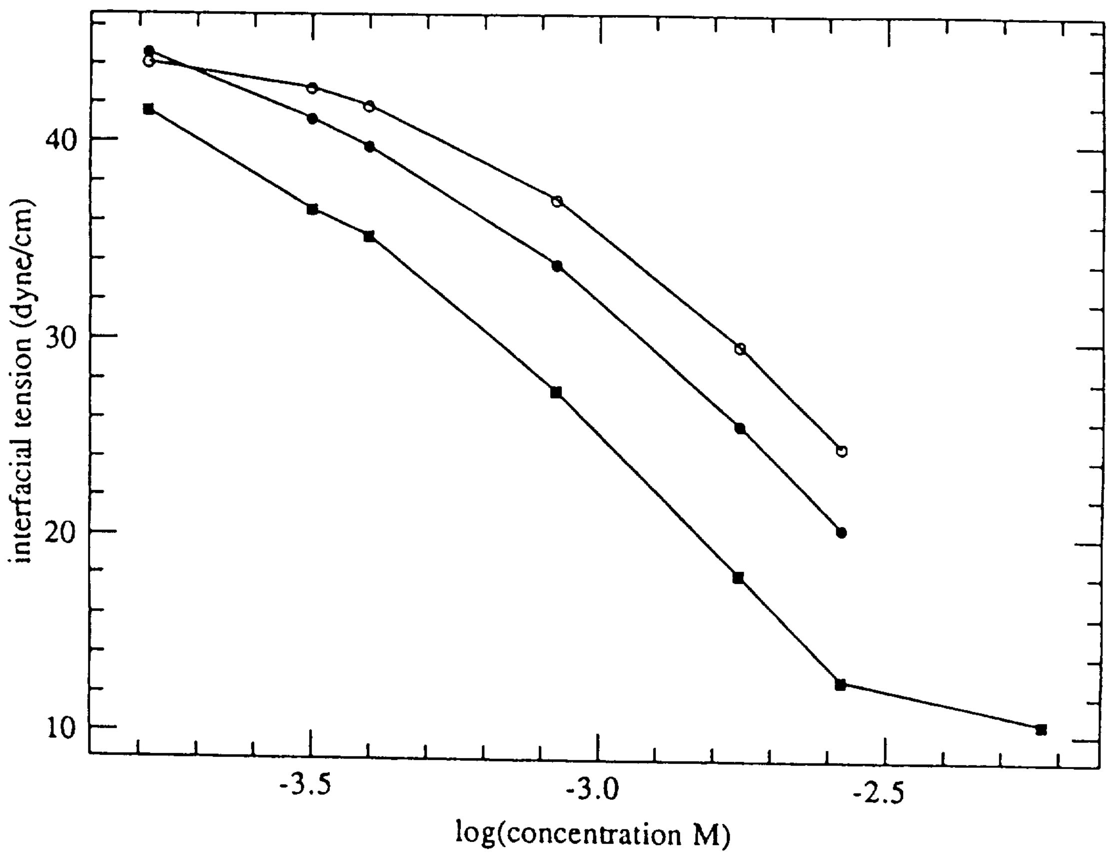


Fig. 14 Interfacial tension at different SDS concentrations. Circles and squares denote results obtained within five minutes and one hour after the drop is introduced into the solution respectively. The open circles represent results measured by Rehfeld using drop's weight method. Rehfeld's data were also taken within five minutes after the drop was formed.

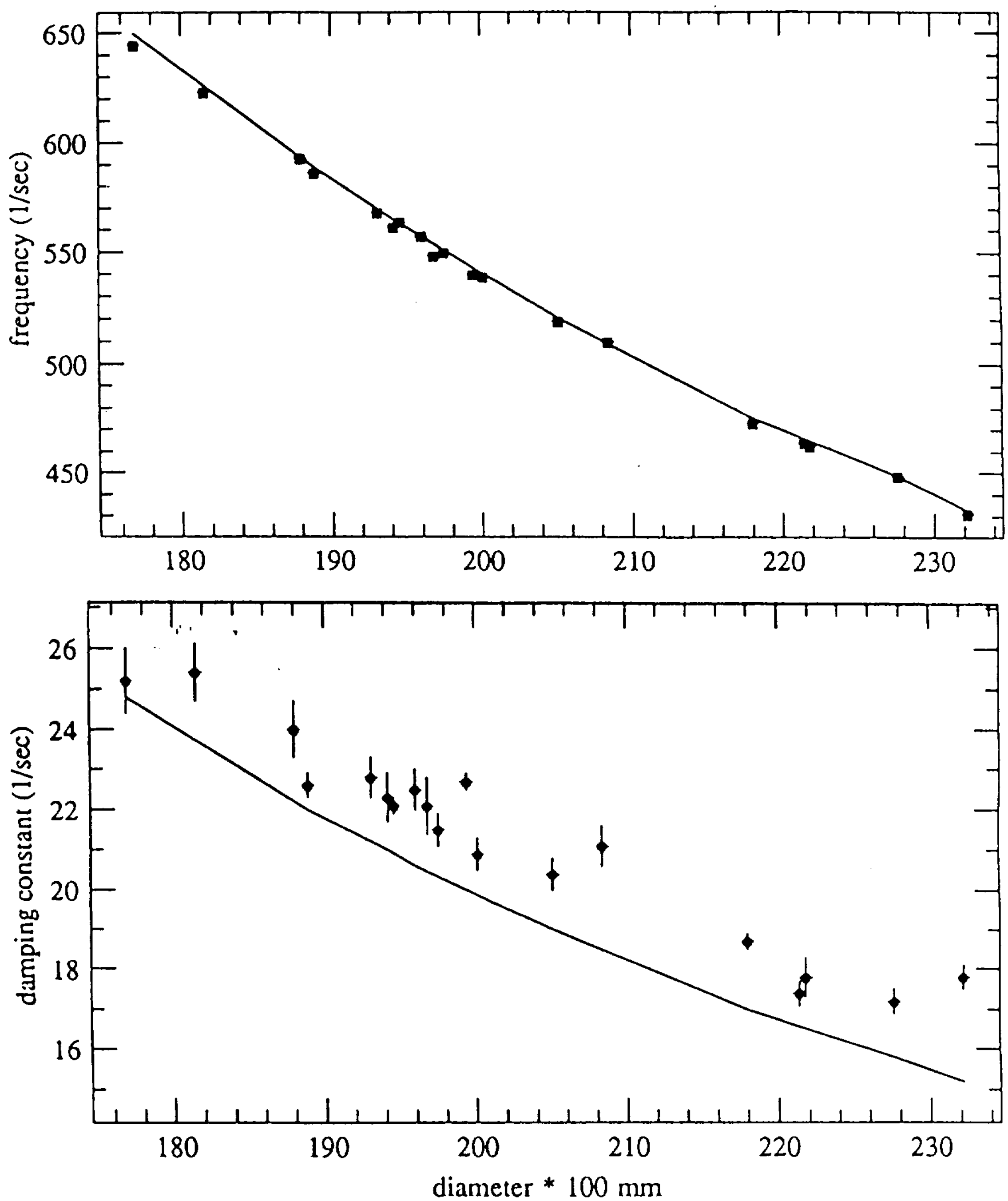


Fig. 4 Frequency and damping constant versus diameter for hexane drops in pure water at 24±2°C. The solid curves are the theoretical predictions based on Eq. [1].

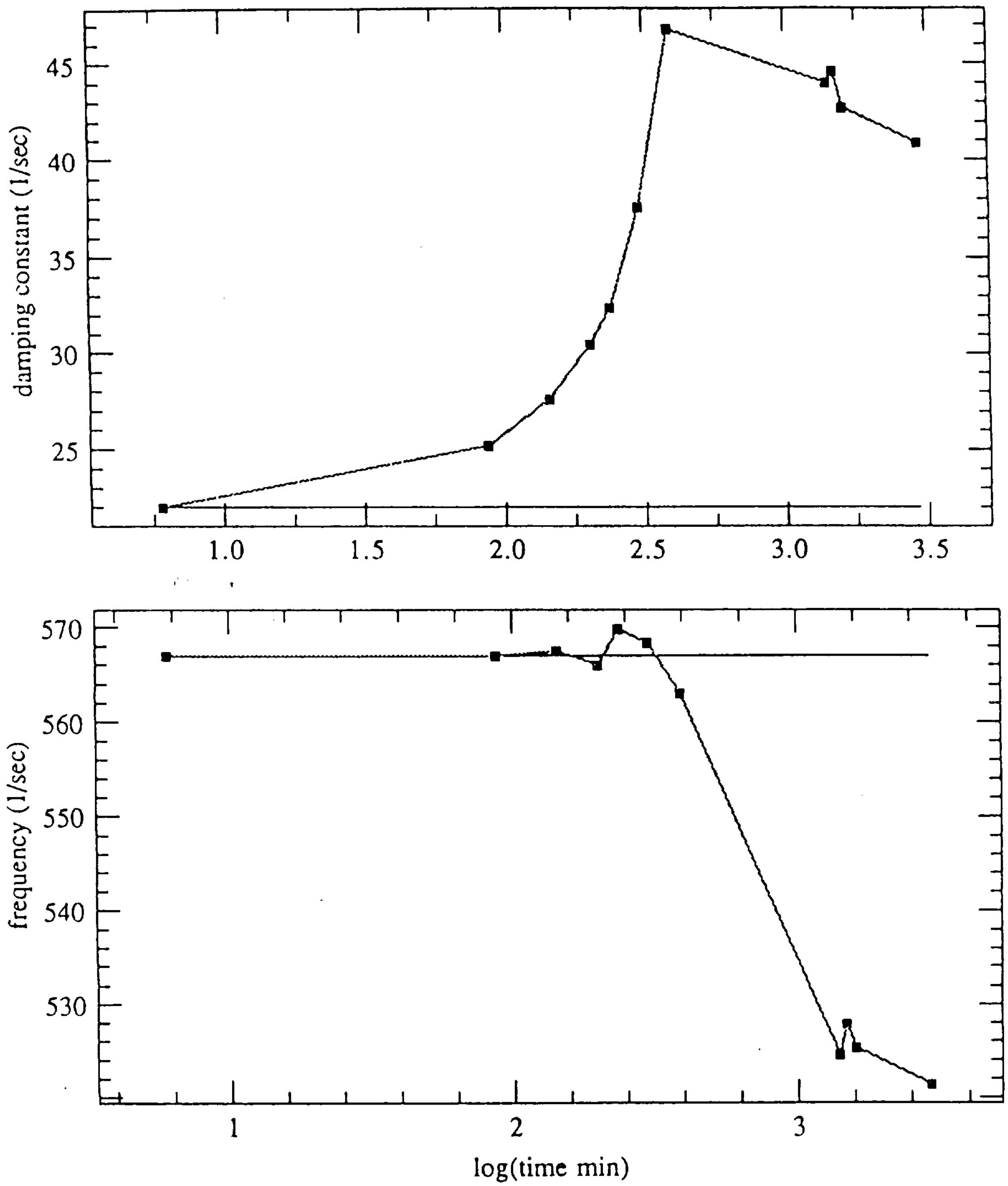


Fig. 3 Time history of the frequency and damping constant for a hexane drop of a diameter 0.954±0.004 mm in pure water at 22°C. The solid curves are the theoretical predictions based on Eq. [1].