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UNDERCOOLING OF ACOUSTICALLY LEVITATED MOLTEN DROPS

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Abstract

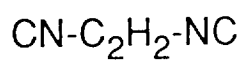
We have observed that the acoustically levitated molten SCN drops can generally be undercooled to a degree where the impurities in the drop are responsible for the nucleation of the solid phase. However, we have also observed that ultrasound occasionally terminates undercooling of the levitated drop by initiating the nucleation of the solid at an undercooling level which is lower than that found for the nucleation catalyzed by the impurities in the drop. This premature nucleation can be explained by thermodynamic considerations which predict an increase in effective undercooling of the liquid upon the collapse of cavities. Pre-existing gas microbubbles which grow under the influence of ultrasound are suggested as the source of cavitation. The highly undercooled SCN drops can be utilized to measure the growth velocity of the solid in the deeply undercooled region including the hypercooled region.

Objective

To study the effect of ultrasound on the undercooling of acoustically levitated molten drops.

Experimental Procedure

- * Succinonitrile

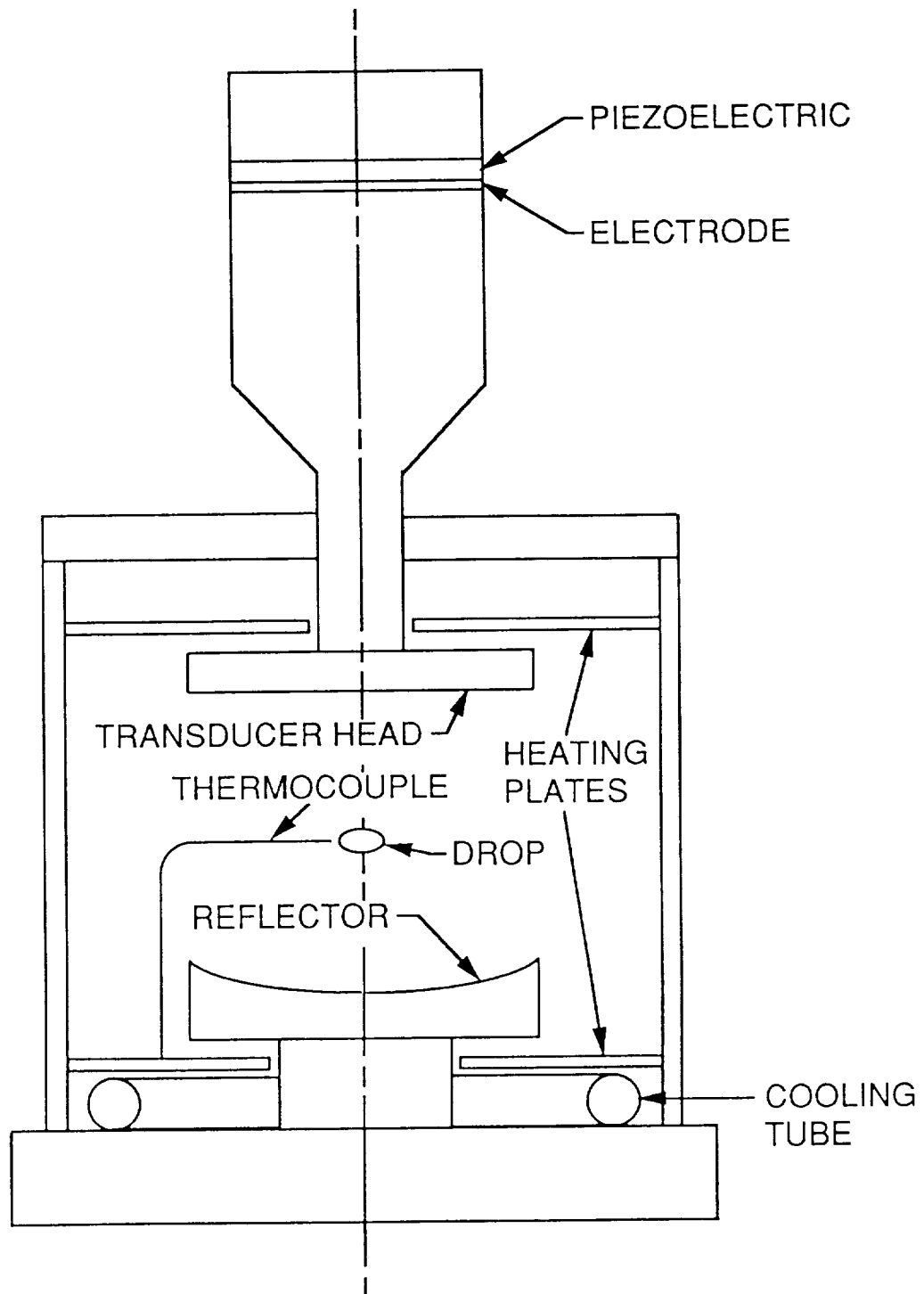


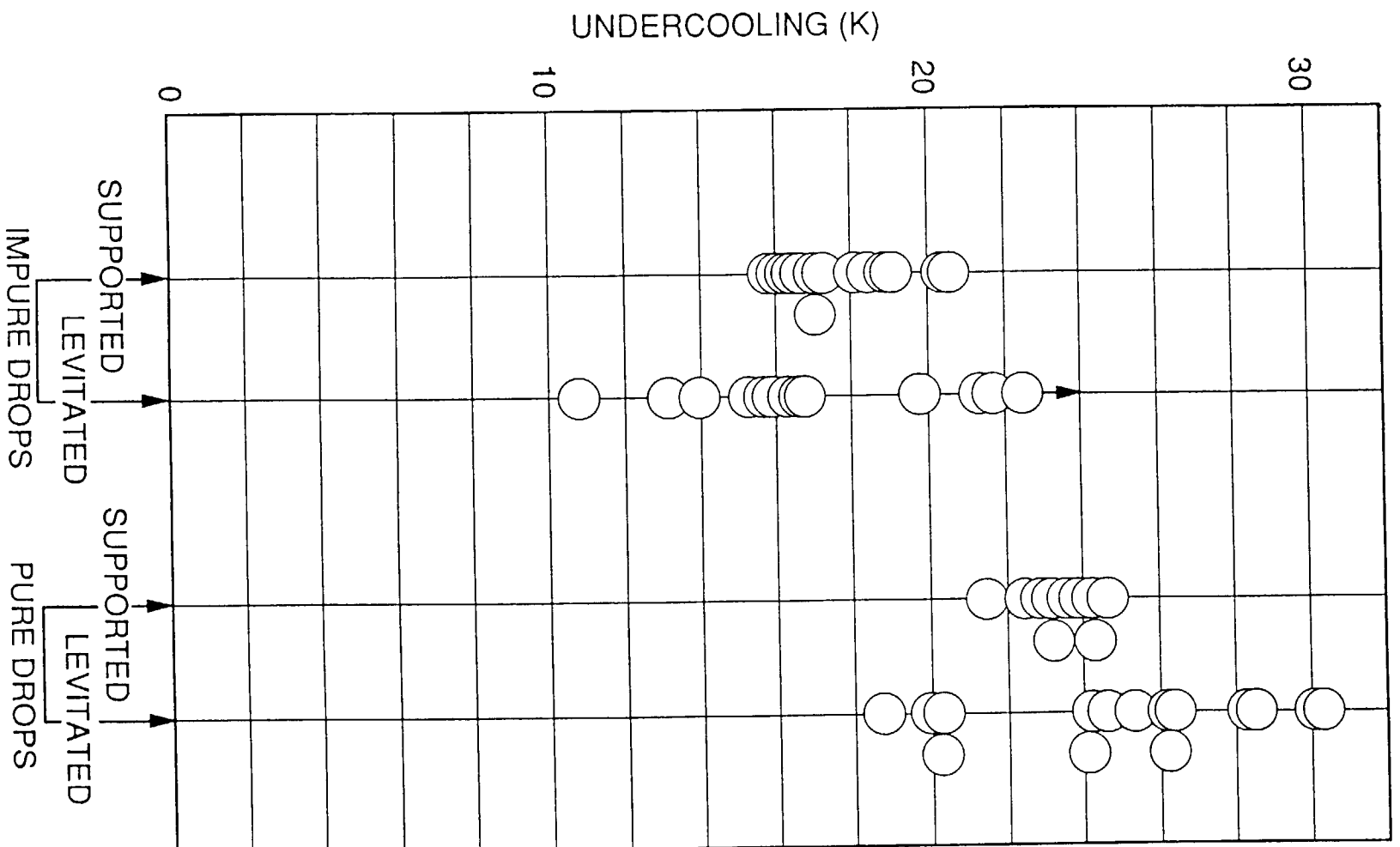
impure (97 %, 54.0 °C)

pure (>99.9 %, 58.0 °C)

- * Undercooling Level

1. acoustically levitated drops
2. mechanically supported drops



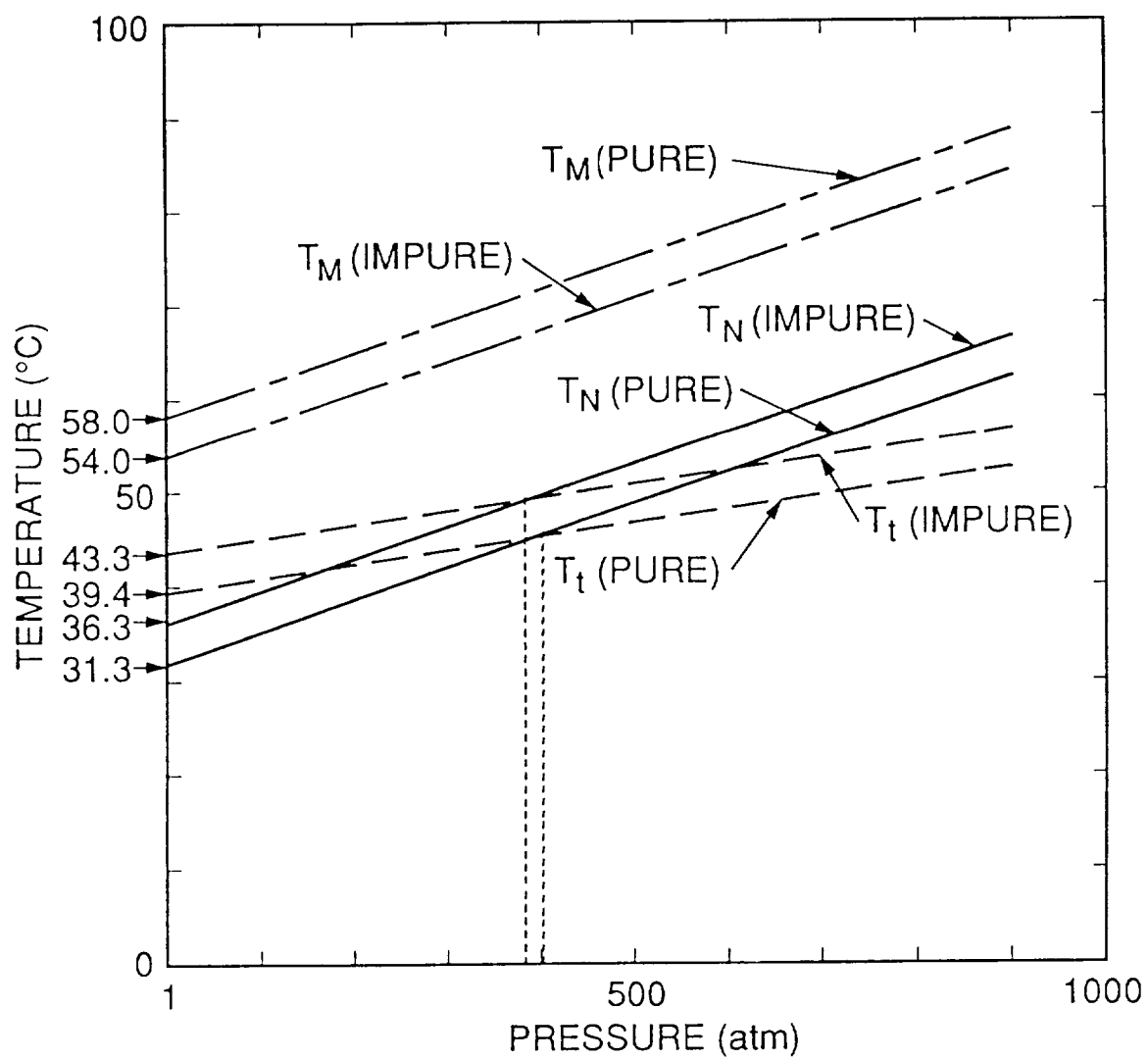


Means and Standard Deviations of the Undercooling Levels

		mean (K)	standard dev.
impure	supported	17.7	1.58
	levitated	16.9 (18.2)	3.64 (3.03)
pure	supported	23.4	0.95
	levitated	24.8 (26.7)	3.72 (2.21)

Possible Causes of Dynamic Nucleation

1. Foreign impurities
2. Collision of subcritical embryos
3. Cavitation



Conclusions

1. Acoustically levitated drops can generally be undercooled to a degree where the impurities are responsible for the nucleation of the solid.
2. Ultrasound occasionally terminates the nucleation of the solid. This premature nucleation can be explained by thermodynamic considerations which predict an increase in effective undercooling of the liquid upon cavitation.
3. SCN drops can be undercooled into the hypercooled region (>23.1 K). The drops can be utilized to measure the physical properties in the deeply undercooled region.

