Acoustic Effects in Classical Nucleation Theory*

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The effect of sound wave oscillations on the rate of nucleation in a parent phase can be calculated by expanding the free energy of formation of a nucleus of the second phase in powers of the acoustic pressure. Since the period of sound wave oscillation is much shorter than the time scale for nucleation, the acoustic effect can be calculated as a time average of the free energy of formation of the nucleus. The leading non-zero term in the time average of the free energy is proportional to the square of the acoustic pressure. The Young-Laplace equation for the surface tension of the nucleus can be used to link the time average of the square of the pressure in the parent phase to its time average in the nucleus of the second phase. Due to the surface tension, the pressure in the nuclear phase is higher than the pressure in the parent phase. The effect is to lower the free energy of formation of the nucleus and increase the rate of nucleation.