## 6.4.3 Effect of Interfacial Roughness

One of the features that can alter the thermal inhibition of bubble growth occurs when the bubble surface becomes sufficiently roughened to effectively eliminate the thermal boundary layer. This may occur because of an interfacial instability or because of some external interference with the interface. Shepherd and Sturtevant (1982) and Frost and Sturtevant (1986) examined rapidly growing bubbles near the limit of superheat and found growth rates substantially larger than expected when the bubble was in the thermally inhibited range of parameters. Photographs of those bubbles (see figure 1) show that the interface is rough and irregular in places. The enhancement of the heat transfer caused by this roughening is probably responsible for the larger than expected growth rates. Shepherd and Sturtevant (1982) attribute the roughness to the development of a baroclinic interfacial instability. In other circumstances, Rayleigh-Taylor instability of the interface could give rise to a similar effect (Reynolds and Berthoud 1981). A flow with a high turbulence level could have the same consequence and it seems clear that this suppression of the thermal inhibition plays a key role in the phenomenon of vapor explosions (section 7.6.4).

Figure 1: Typical photographs of a rapidly growing bubble in a droplet of superheated ether suspended in glycerine. The bubble is the dark, rough mass; the droplet is clear and transparent. The photographs, that are of different events, were taken 31, 44, and 58 $\mu s$ after nucleation and the droplets are approximately 2 $mm$ in diameter. Reproduced from Frost and Sturtevant (1986).