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Characteristics of bubble sounds in kitchen and volcano

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Bubbling process in cooking is usually associated with sound generation Heated mushy soup generates sporadic,sometimes low frequency isolated bubble sounds whereas boiled water for spaghetti and soba emits nearly continuous, sometimes high tone sounds. An able chef can sense thermal state of the heated material by hearing bubble sounds. In volcanic activity bubbling sounds are also considered to give important information. Sometime they are closely related with tremors. In both cooking and volcanos the physical process of the sound generation during bubbling is still not well understood. The very basic process is associated with collapse of bubbles, but the control of fluid properties is still unknown. Here we focus on the role of fluid viscosity and viscoelasticity. To demonstrate this we tried a series of cocking experiments.

Aqueous solutions with different amount of starch are prepared. As the amount of starch increases the viscosity increases and the solution exhibits viscoelasticity. To see this effect more clearly we also prepare CMC solution, which is a famous ingredient to generate viscoelasticity at low concentration. Two types of bubble sounds are measured. One is the sounds associated with bubbling by air-bubbler commercially used in goldfish bowl. Another is the sound of boiling in a heated pan. 2-5 sec.long audio signals by microphone are spectrum-analyzed.

Power spectrum of the sound changes with the amount of added starch. At higher concentration low frequency contents below 1KHz becomes larger, whereas higher frequency content at 3-4 KHz becomes evident. We focus on this increase at higher frequency in relation to the emergence of viscoelasticity.