

# ACOUSTICS OF BOILING WITH UNDERHEATING ON A LASER HEATING ELEMENT

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We study acoustic signals arising during cavitation initiated by laser heating of water in the vicinity of the end of an optical fiber immersed in water. It is shown that the growth and collapse of the vapor phase in the vicinity of the end of the optical fiber (laser heating element), along which laser radiation propagates, generate acoustic signals characteristic of the elementary act of boiling, which precede the appearance of large-amplitude signals. It has been established that large amplitude signals are caused by shock waves that arise during the collapse of the main bubble and secondary bubbles - "rebounds".

**Keywords:** cavitation, vapor bubbles, laser radiation, heating, boiling, sound pulse, acoustic vibrations, shock waves

## References

1. Nesis E.I. Kipenie zhidkostej. Iz-vo «Nauka». Moskva. 1973. 280 p.
2. Chudnovskij V.M., Levin A.A., Yusupov V.I., Guzev M.A., Chernov A.A. The formation of a cumulative jet during the collapse of a vapor bubble in a subcooled liquid formed as a result of laser heating. *International Journal of Heat and Mass Transfer*. 2020. Vol. 150. P. 119286, <https://doi.org/10.1016/j.ijheatmasstransfer.2019.119286>.
3. Deng R., He Y., Qin Y., Chen Q., Chen L. Measuring pure water absorption coefficient in the near-infrared spectrum (900–2500 nm). *Yaogan Xuebao - Journal of Remote Sensing*. 2012. Vol. 16. No. 1. P. 192-206.
4. Adamova T.P., Chudnovskij V.M., Elistratov D.S. Samoproizvol'noe (spontannoe) vskipanie zatoplennykh struj, generiruemyyh pri kollapse parovykh puzyr'kov. *Pis'ma v ZhTF*. 2022. Vol. 48. Iss. 1. P. 19-21. DOI: 10.21883/PJTF.2022.01.51873.18991
5. Dorofeev B. M., Volkova V. I. Akusticheskij metod issledovanija rosta i shlopyvaniya puzyr'ka para pri kipenii. *Akust. zhurn*. 2003. Vol. 49. No. 6. P. 794-798.



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