

Further study on transient boiling phenomena generated by microwave heating

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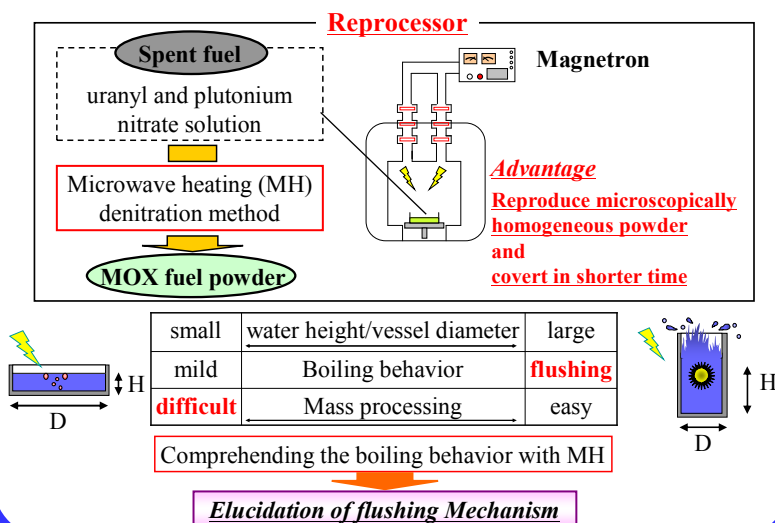
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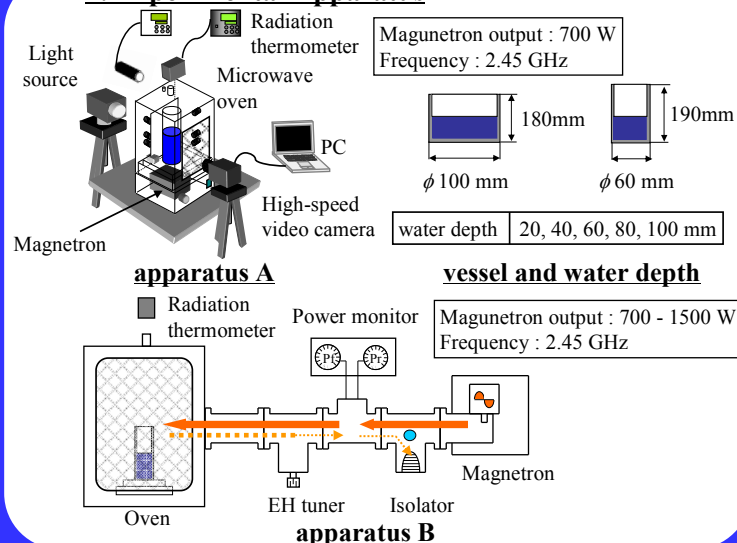
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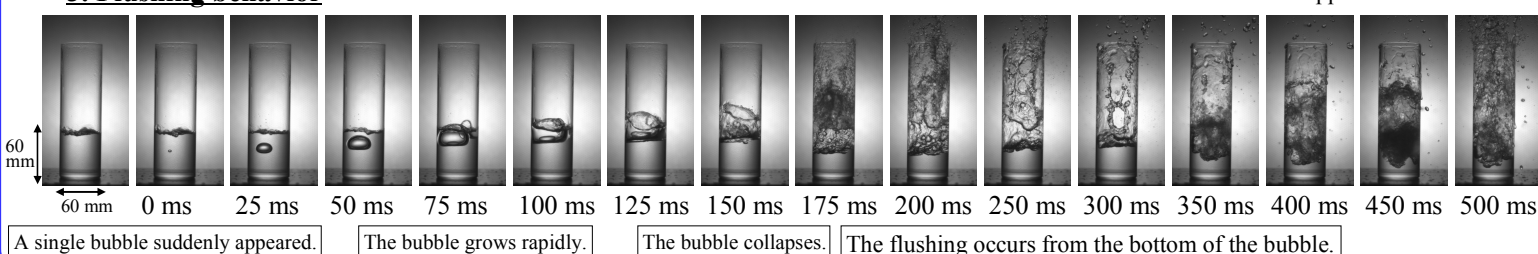
1. Introduction and objective



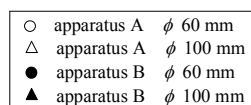
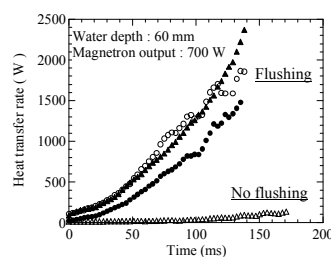
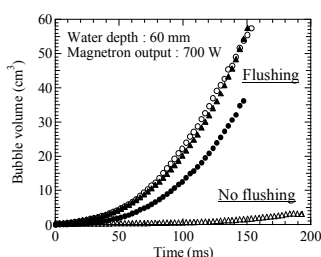
2. Experimental Apparatus



3. Flushing behavior



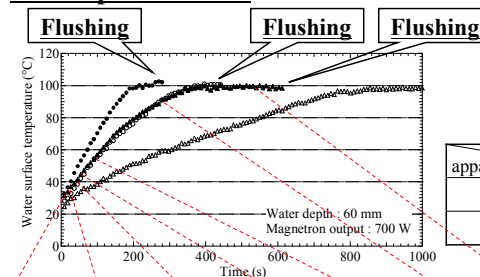
4. Bubble volume



Heat for bubble growth

$$Q = \rho_g \cdot \frac{dV}{dt} \cdot h_{fg}$$

5. Temperature shift

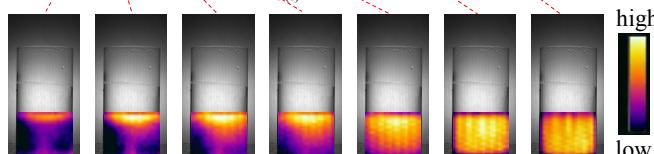


Actual input power supplied from magnetron

$$Q = \rho_l \cdot C_l \cdot \frac{dT}{dt} \cdot V$$

apparatus	Vessel diameter	φ 60 mm	φ 100 mm
apparatus A		158 W	183 W
apparatus B		258 W	416 W

Efficiency of specified input power of magnetron
A : 25 %
B : 35 - 60 %



In the occurrence of the flushing, the bubble volume increase rapidly.

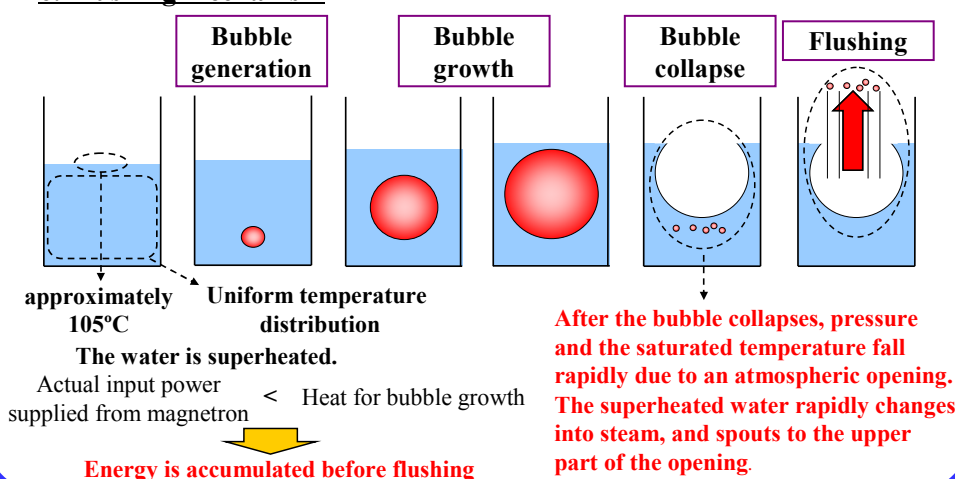
Heat for bubble growth reaches up to 1500 W or more.

This value exceeds the specified input power of magnetron 700 W.

Water surface temperature is about 105°C, superheated.

Temperature distribution becomes uniform.

6. Flushing mechanism



7. Conclusion

- The flushing behavior is observed by experiment with the high speed video camera. A single bubble grows rapidly. After bubble collapse, the flushing occurs from the bottom of the bubble. Afterward, flushing up two or more times is generated.
- In the occurrence of flushing, it was confirmed that the bubble extended rapidly, compared with the case of no flushing. Heat for bubble growth when the flushing occurs reaches up to 1500W or more.
- In the occurrence of flushing, water surface temperature is at 105 °C. So it seems to be in a superheated state. And temperature distribution become uniform. These results show a superheated state in water.
- It suggests that water accumulates energy because the heat for bubble growth is larger than actual input power supplied from magnetron.