

## Appendix A: Supplemental Document

### Plasma emission intensity expansion of Zr metal and Zr oxide via microwave enhancement laser-induced breakdown spectroscopy

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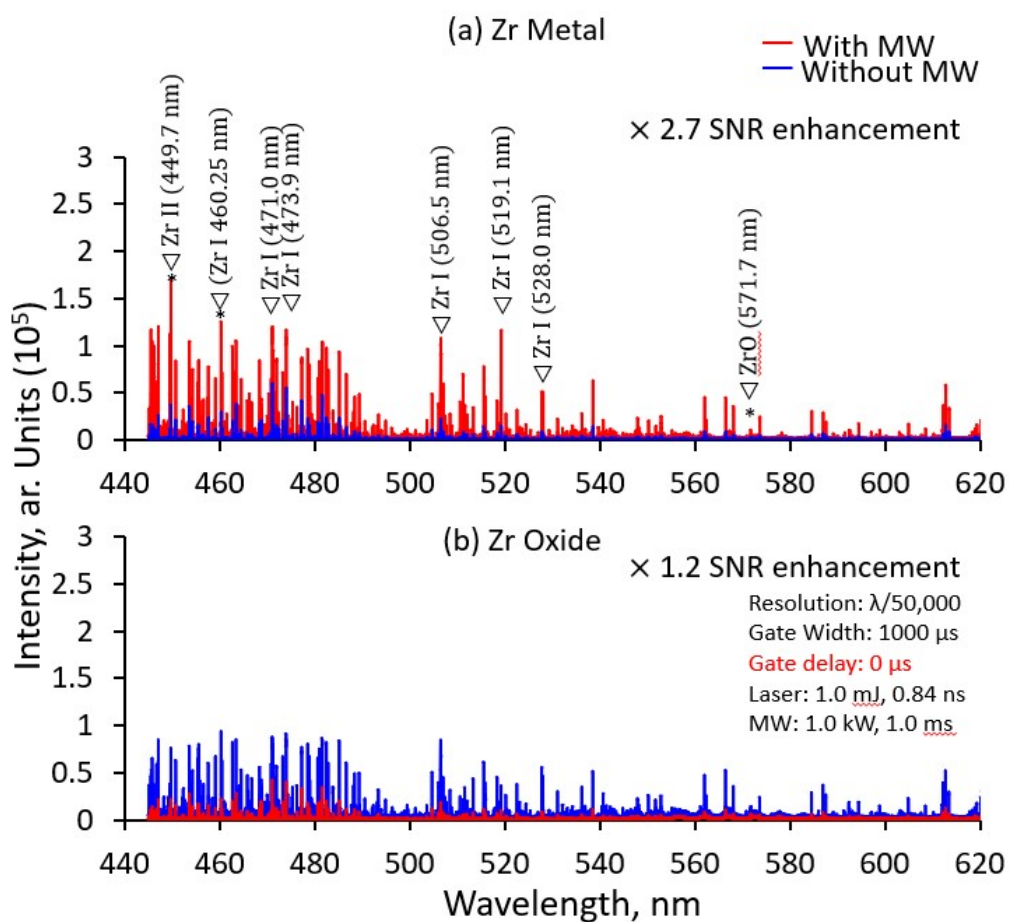


Fig. S1. The emission spectra of Zr (a) metal and (b) oxide from 445 to 620 nm, where the continuum emissions are usually high.

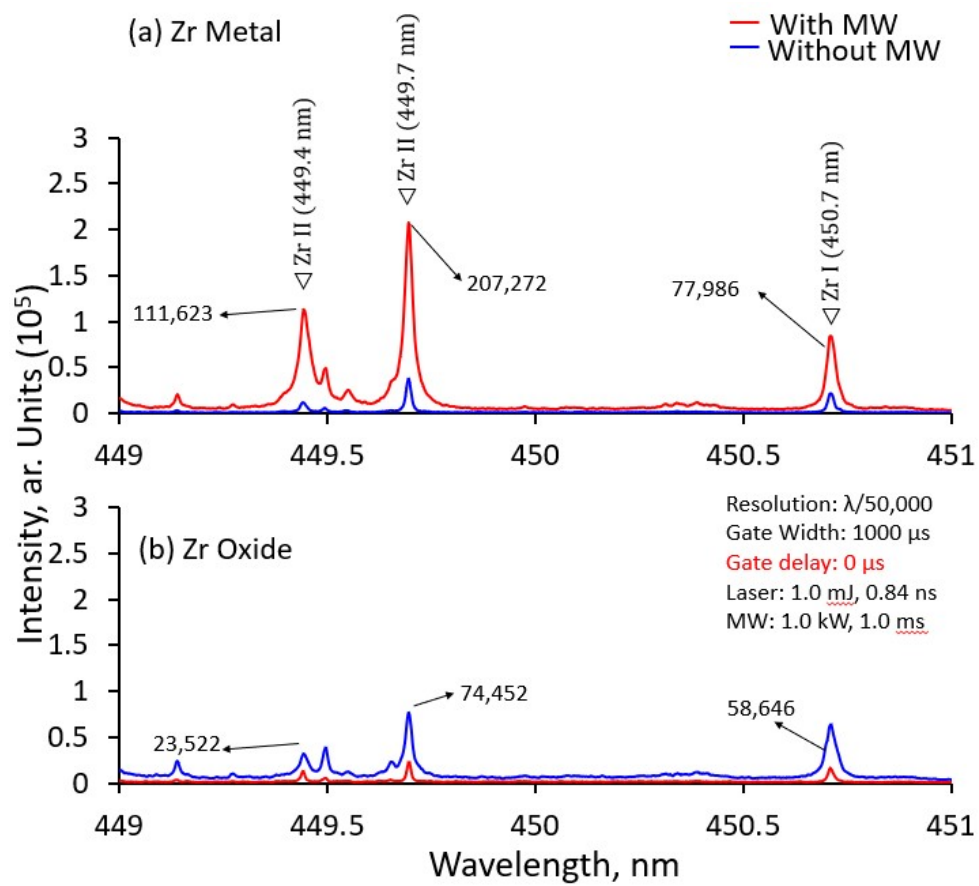


Fig. S2. Emission intensity difference between (a) metal and (b) oxide with the 449–451 nm.

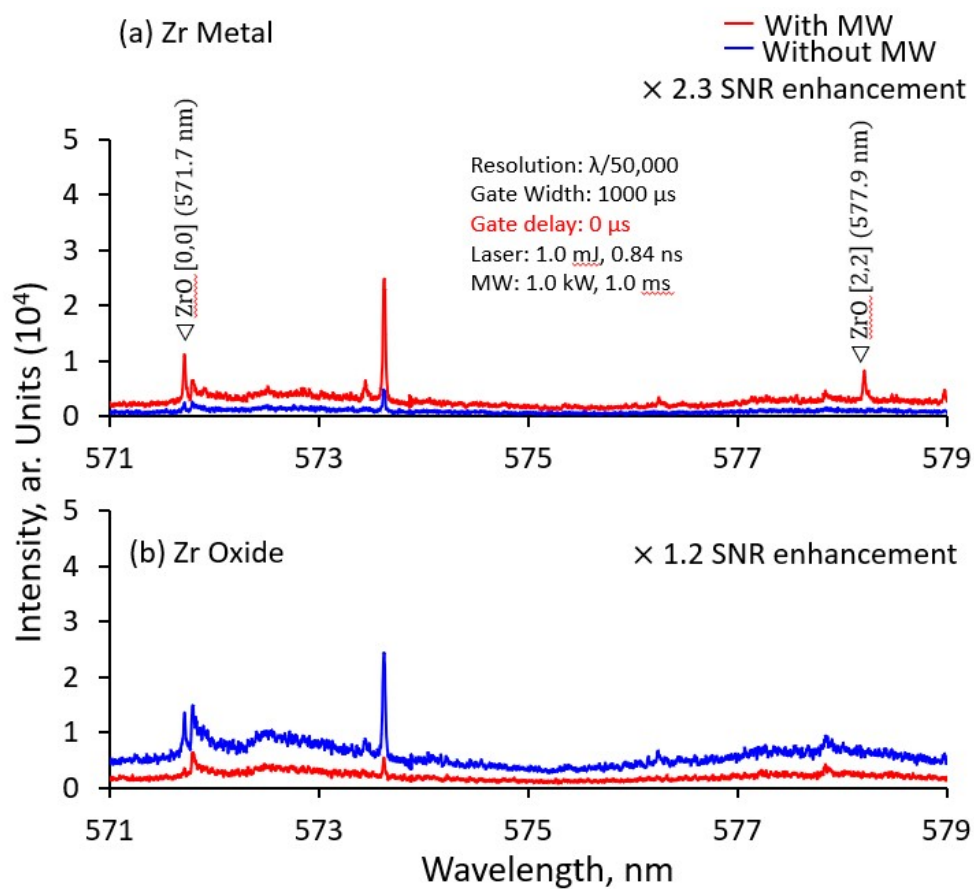


Fig. S3. Molecular emission, ZrO spectrum of (a) metal and (b) oxide.