**Supporting Information (SI)**

# Flexible-Design in Controllable Synthesis of Ru Catalyst toward Enzymatic and Electrochemical Hydrogen Peroxides Performance

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Xi Hu and Yujun Yang contributed equally in this work.

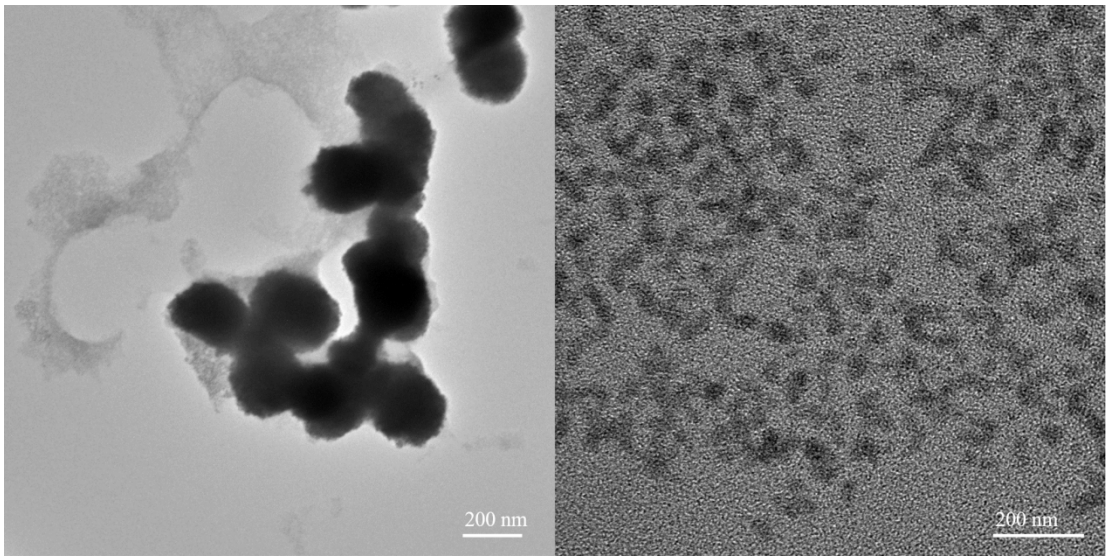


**Figure S1.** TEM images of as synthesized Ru NPs at room temperature for one hour.

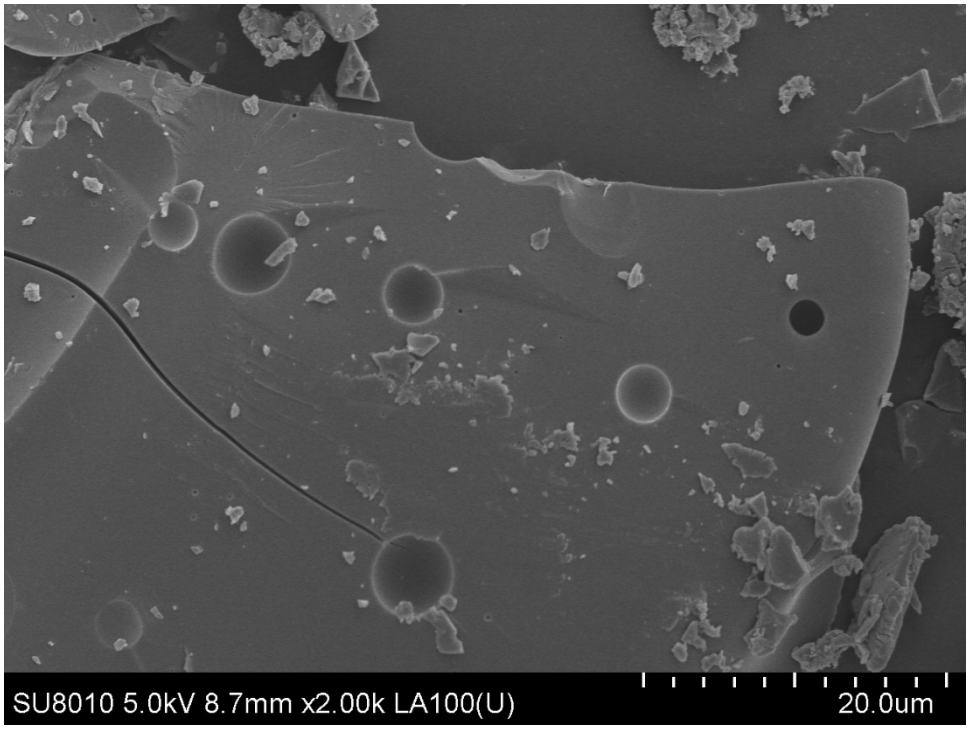


**Figure S2.** SEM image of as synthesized Ru NPs.

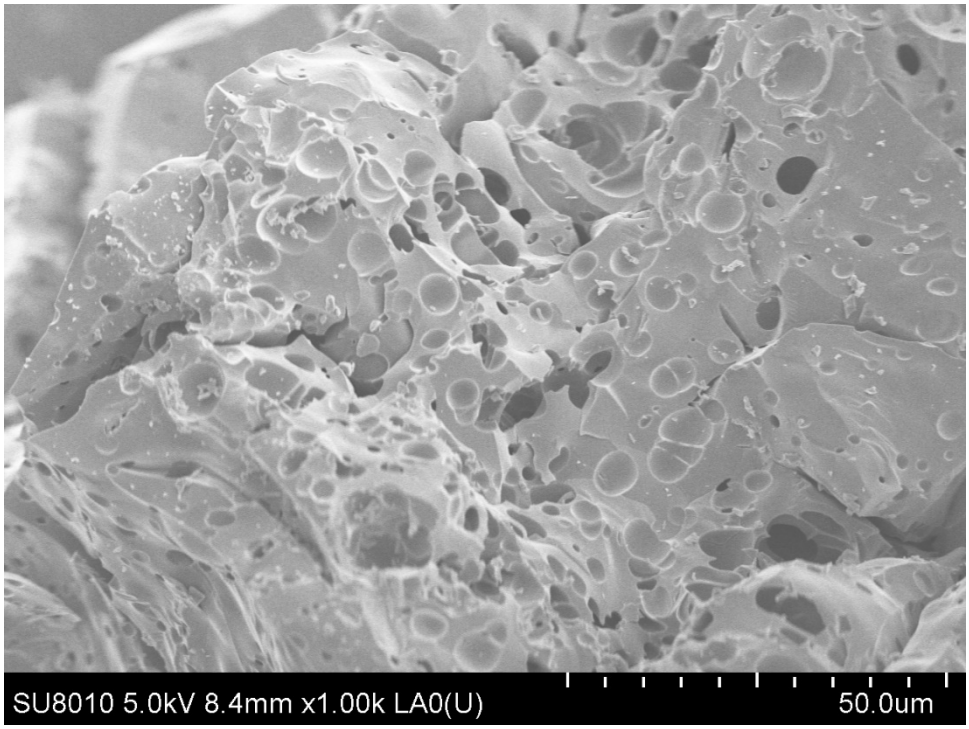


**Figure S3.** SEM image of annealed Ru NPs.

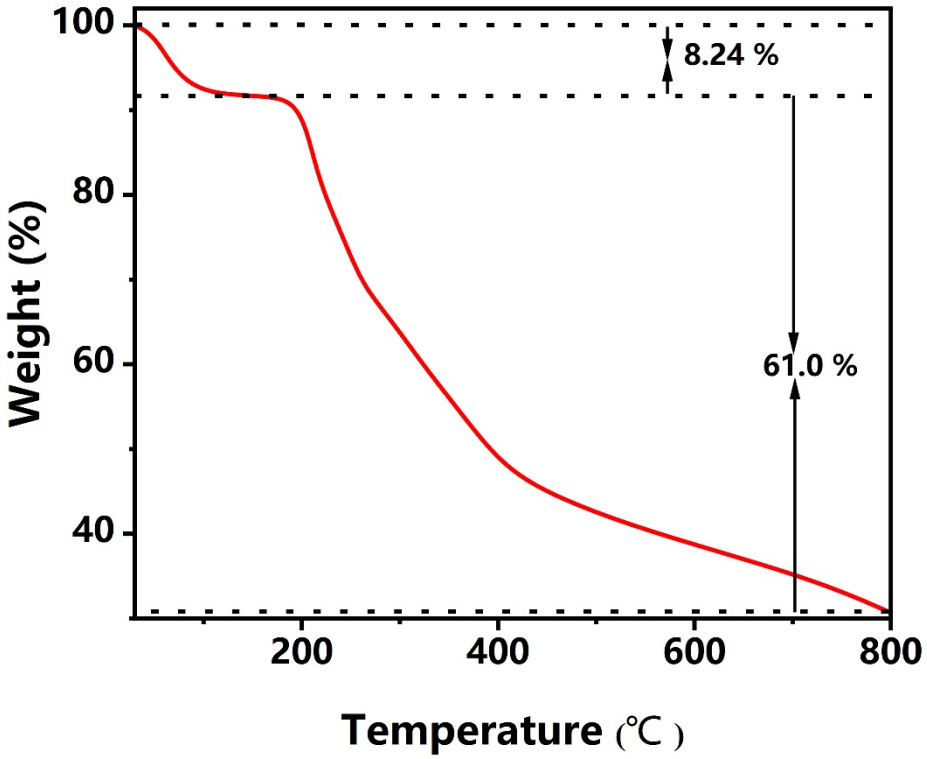


**Figure S4.** TGA curves of Ru NPs.

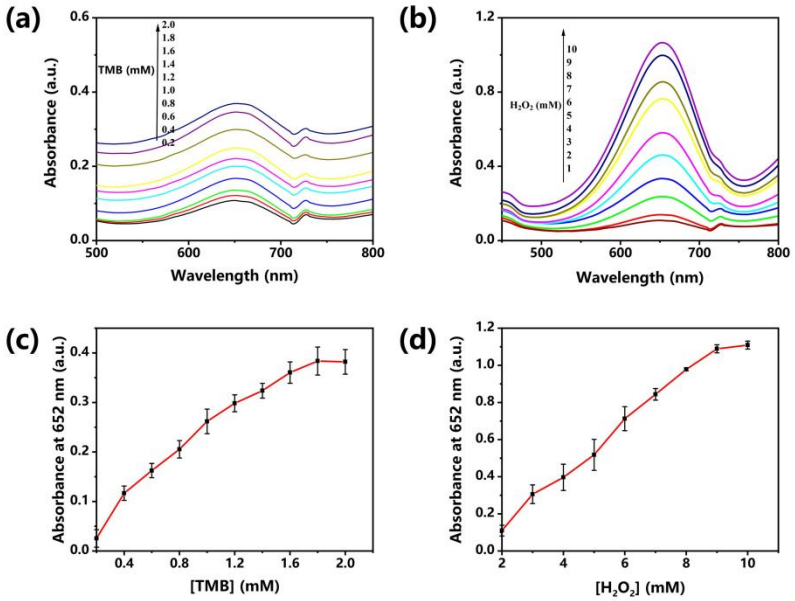


**Figure S5.** HRP-like activity of Ru NPs during oxidation of TMB. (a, c) UV-vis absorption spectra and (b, d) absorbance at 652 nm of Ru NPs (200 μg $mL^{-1}$) incubated at different concentrations of TMB and $H_2O_2$ for 10 mins.

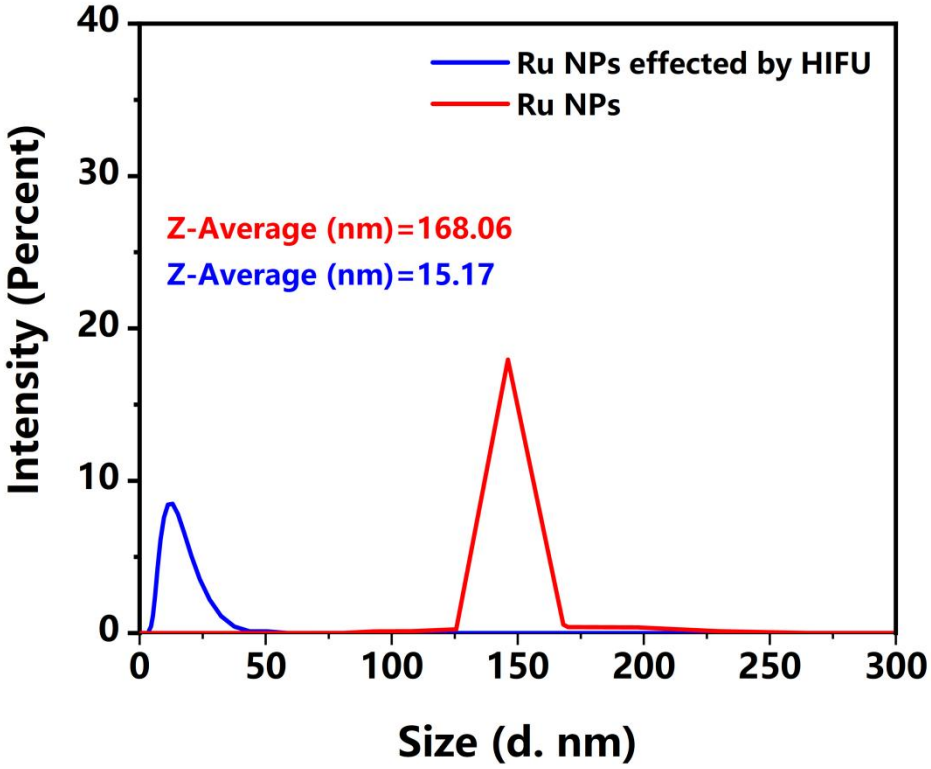


**Figure S6.** DLS data of Ru NPs and Ru NPs effected by HIFU (10 MPa, 4000 W).

# Supporting Information (SI)

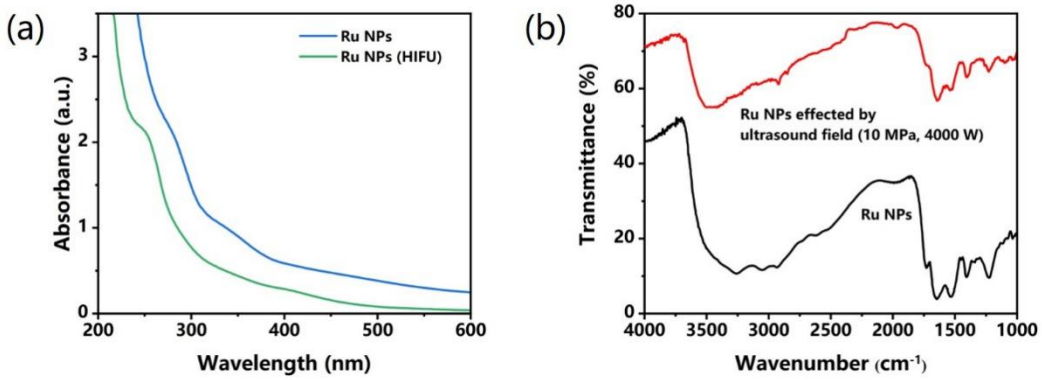


**Figure S7.** (a, b) UV-*vis* absorbance spectra and FTIR spectra of Ru NPs effected by ultrasound field (10 MPa, 4000 W).

**Table S1.** Comparison of the kinetic parameters of different catalysts.

| Catalyst | Substrate | $K_m$ (mM) | $V_{max}$ ($\times 10^{-7}$ M $s^{-1}$) | Ref. |
|---|---|---|---|---|
| HRP | TMB | 0.434 | 1.00 | 1 |
| | $H_2O_2$ | 3.70 | 0.871 | |
| Ir NPs | TMB | 0.33 | 12.7 | 2 |
| | $H_2O_2$ | 44.28 | 13.7 | |
| Pt NPs | TMB | 0.86 | 17.4 | 2 |
| | $H_2O_2$ | 7.92 | 53.5 | |
| Pt nanoplates | TMB | 0.17 | 10.1 | 3 |
| | $H_2O_2$ | 82.7 | 17.7 | |
| $RuO_2$ NPs | TMB | 0.24 | 1.9 | 4 |
| | $H_2O_2$ | 212 | 2.05 | |
| Ru NPs | TMB | 0.234 | 4.95 | 5 |
| | $H_2O_2$ | 2.206 | 34.96 | |
| Ru frames | TMB | 0.0603 | 1.34 | 6 |
| | $H_2O_2$ | 318 | 0.741 | |
| $Co_3O_4$ | TMB | 0.36 | 2.49 | 7 |
| | $H_2O_2$ | 6.53 | 130 | |
| $Fe_3O_4$ | TMB | 0.098 | 0.344 | 1 |
| | $H_2O_2$ | 154 | 0.978 | |

**Table S2.** Comparison of the detection $H_2O_2$ of different catalysts.

| Probe | Linear range(μM) | LOD (μM) | Ref. |
|---|---|---|---|
| Ru NPs | 500-100000 | 1.45 | This work |
| Ag/graphene oxide | 100-20000 | 1.9 | 8 |
| Pt/carbon nanotube | 5-25000 | 1.5 | 9 |
| FePPOPs-$SO_3H$ | 50-1800 | 26.7 | 10 |
| Au/$Co_3O_4$-$CeO_x$ | 10-1000 | 5.29 | 11 |
| PtPd-$Fe_3O_4$/C | 0.02-67 | 0.005 | 12 |

## References


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