

Rapid and efficient degradation of organic contaminants with microplasma electrochemistry method

Liyuan Zheng^a, Yakun Song^a, Kerong Li^a, Lingyu Zhang^a, Yuexiang Lu^b, Shuang Liu^{c,*},
Zhe Wang^{a,b,*}, Xiangke Wang^a

^a The MOE Key Laboratory of Resources and Environmental System Optimization, College of Environmental Science and Engineering, North China Electric Power University, Beijing 102206, China

^b Institute of Nuclear and New Energy Technology, Tsinghua University, Beijing 100084, China

^c Nuclear Research Institute for Future Technology and Policy, Seoul National University, Seoul 08826, Republic of Korea

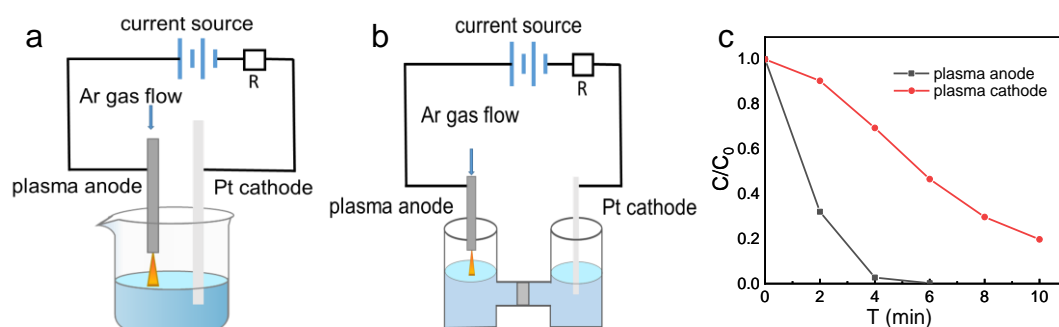


Fig. S1 Schematic of the microplasma discharge experimental setup in the non-separated (a) and separated (b) electrode systems. (c) Degradation of RhB in the non-separated system.

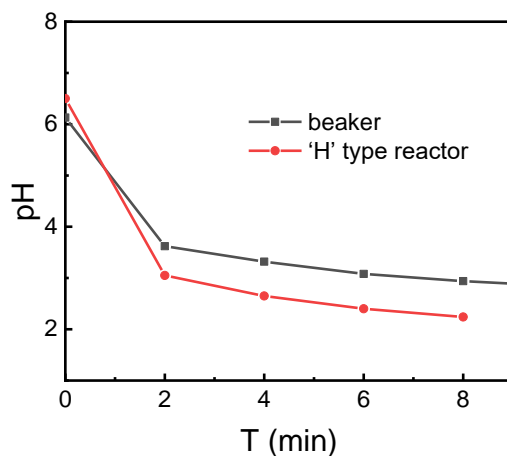


Fig. S2 pH changes of the RhB solution treated with microplasma anode in different systems.

To confirm the proposed mechanism, we proposed oxidizing KI experiments. Based on the reaction with KI, the concentration of AOPs formation was estimated by colorimetric method. The method consists in mixing 4 mL 0.1M KI and 100 μ L 0.01M ammonium molybdate with the sample, which contains residual hydrogen peroxide, and allowing to react for 15 min. The absorbance was measured at $\lambda = 315$ nm with a spectrophotometer and the result was listed below (Fig. S3). It was clear that more AOPs were obtained in air than the N_2 atmosphere. While, this experiment only confirmed the formation of AOPs and it is still unclear to verify the generation of H_2O_2 during the microplasma treatment.

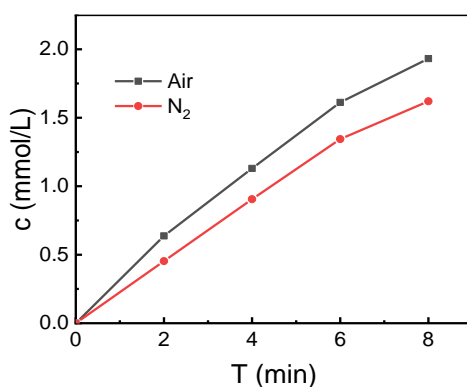


Fig. S3 The concentration of AOPs treated with microplasma anode under different atmosphere with KI method.

Because the lifetime of the reactive radicals is quite short and most of them are shorter than 1 min. Then the solutions placed for 10 minutes after treating with microplasma were measured with $TiSO_4$ method, which was mainly applied to detect the production of H_2O_2 or hydroxyl radicals. The results in Fig. S4a showed that after placed for 10 minutes, the concentration of the active species was enhanced other than disappeared. It also indicated the long lifetime of the active species, which might be recognized as H_2O_2 . Besides, the RhB solution was treated with microplasma anode for 2 min and then turn off the microplasma. It was clear that the RhB was continuous degraded by the active species during the next 8 min (Fig. S4b), which also verified the generation of H_2O_2 during the treatment of microplasma. And the detailed description has been listed in the revised manuscript.

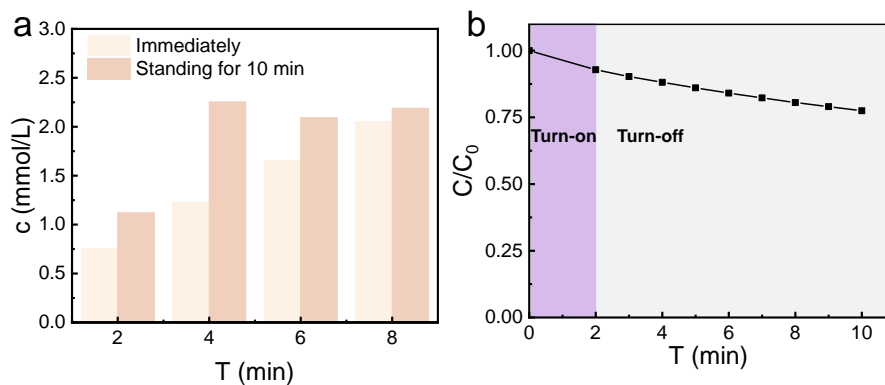


Fig. S4 (a) The concentration of H₂O₂ treated with microplasma anode with TiSO₄ method. (b) The degradation of RhB treated with microplasma for 2 min and then turn off the microplasma.

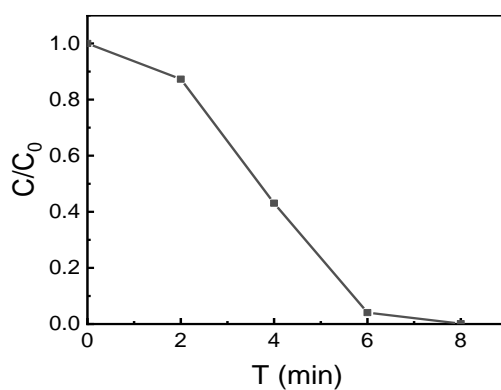


Fig. S5 Degradation of MB with microplasma anode.

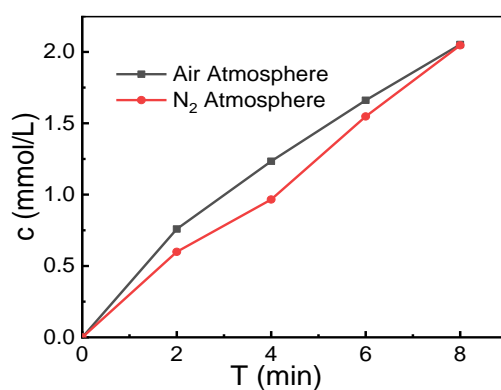


Fig. S6 The concentration of H₂O₂ generated with Ar plasma changed with the treatment time.

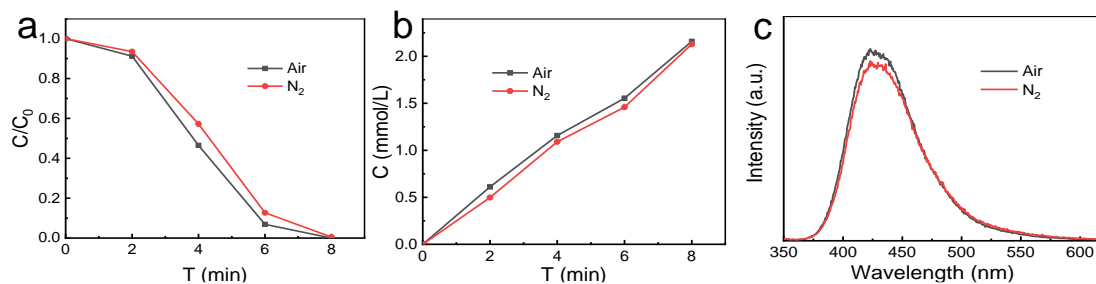


Fig. S7 Under N_2 plasma, degradation diagram of RhB (a), concentration of H_2O_2 as a function of treatment time (b) and fluorescence spectrum of NaTA (c) in different gas environments.

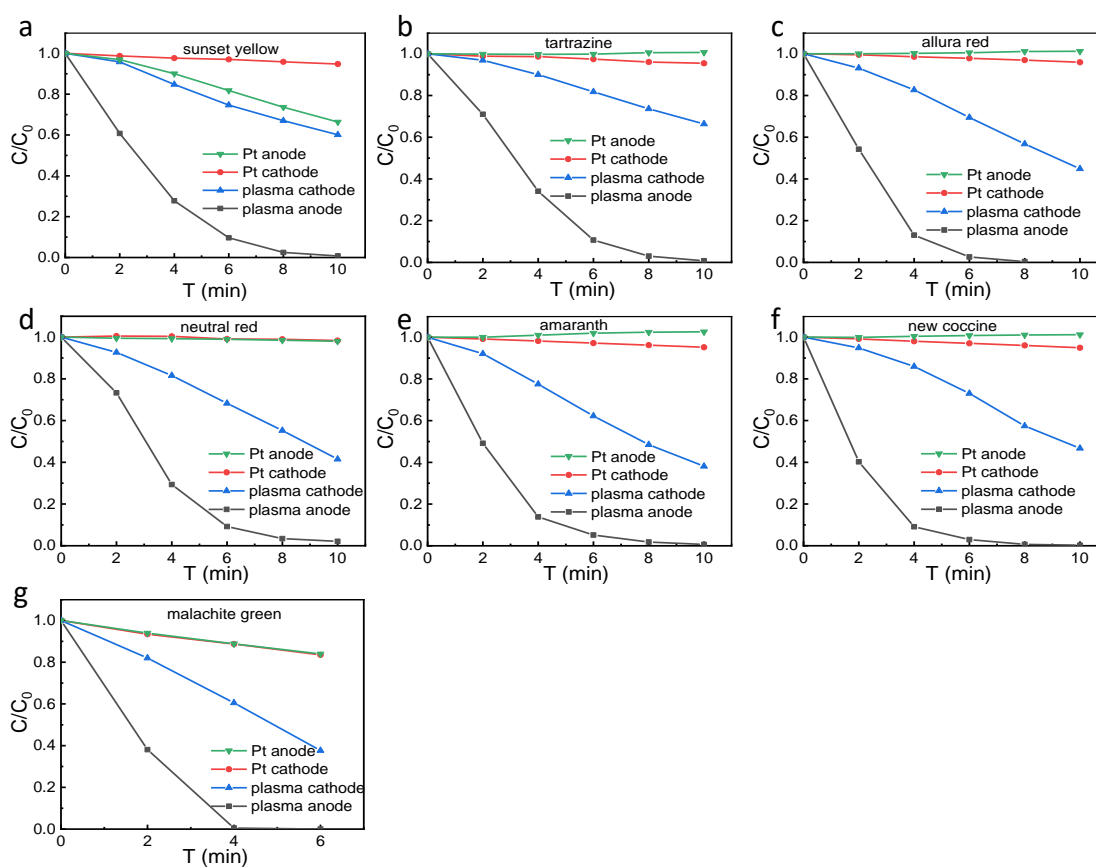


Fig. S8 The degradation diagram of sunset yellow (a), tartrazine (b), allura red (c), neutral red (d), amaranth (e), new coccine (f), malachite green (g) under plasma treatment.