Supplementary Material

Degradation of Pyrene in Contaminated Soil by the Dielectric Barrier Discharge combined with the $MnFe_2O_4$ catalyst

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The degradation efficiency is calculated as follows:

$$\text{Degradation efficiency} = \frac{C_0 - C}{C_0} \times 100\% \quad \text{(Eq. S1)}$$

Where C_0 and C are the initial concentration (at time 0) and the momentary concentrations (at time t), respectively. In the experiment, the V-q Lissajous graph method (V-q trajectory method) was used to measure the electrical parameters such as discharge power. The formula for calculating the current flowing through the loop and the discharge power during discharge is as follows:

Power E for a single cycle

$$E = \int_0^T U(t)I(t)dt = \int_0^T U(t)\frac{dQ(t)}{dt}dt = \int_0^T U(t)dQ(t) \quad \text{(Eq. S2)}$$

Where U is the voltage across the additional capacitor, I is the current across the additional capacitor.

Further calculation to obtain the power P of the reactor:

$$P = f \times E \quad \text{(Eq. S3)}$$

Where *f* is the frequency of the pulse power, and E is the single cycle power.

The energy efficiency (G) calculation is defined as follows:

$$G = \frac{m}{P \times t} \quad \text{(Eq. S4)}$$

Where P is the power of the reactor, and t is time of treatment.

Table S1 Distribution of elements on $MnFe_2O_4$

Element	Weight percentage	Atomic percentage
Mn	26.50	17.22
Fe	51.02	32.62
O	22.48	50.16

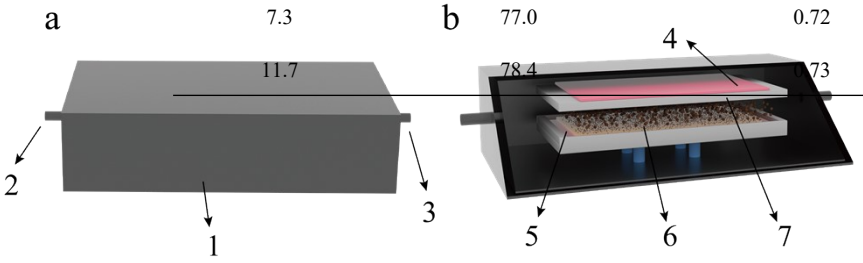
All	100	100

Table S2 The kinetics parameters and G at spinel oxide

Group	k (min^{-1})	R^2	G (mg/kJ)
Without catalyst	0.01436	0.9825	0.8410
$CuFe_2O_4$	0.02124	0.9849	1.0200
$MnFe_2O_4$	0.02677	0.9776	1.0306

Table S3 Effect of soil pH on pyrene degradation: Degradation efficiency of pyrene with different pH in 10 minutes.

pH	Degradation Efficiency (%)	Energy Efficiency (g/kWh)
2.7	61.0	0.57
7.3	77.0	0.72
11.7	78.4	0.73



(1) Shell; (2) Air inlet; (3) Air outlet; (4) High voltage electrode; (5) Low voltage electrode; (6) Contaminated soil; (7) Quartz glass

Fig. S1 Reaction system diagram: (a) Main body of the reaction system, (b) Cross-sectional view of the reaction system.

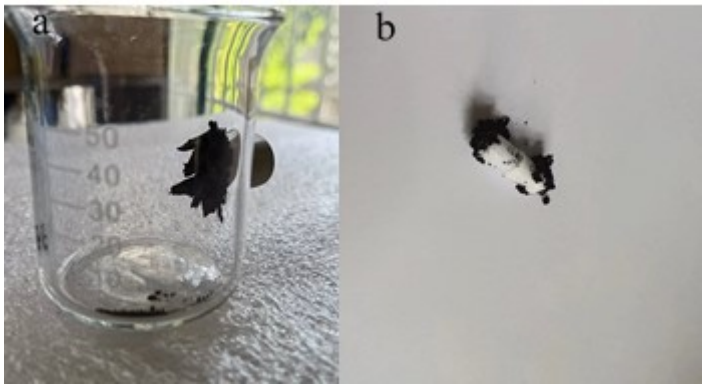


Fig. S2 $MnFe_2O_4$ catalyst. (a) $MnFe_2O_4$ caught by a magnet, (b) $MnFe_2O_4$ caught by a magnetic stirrer.

Fig. S2 proved that the $MnFe_2O_4$ catalyst could be strongly attracted by a magnet, so it could be easily absorbed by the magnetic force.

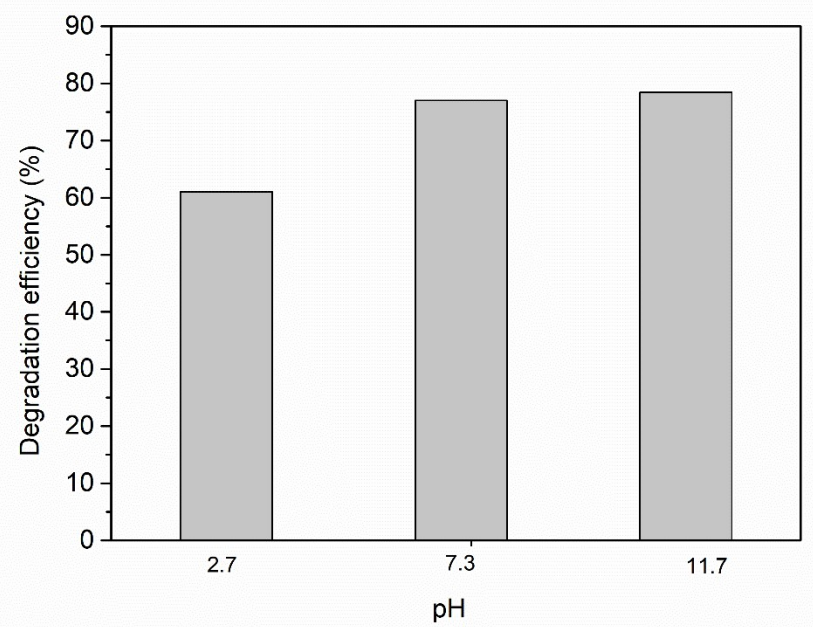


Figure S3 The effect of pH on degradation efficiency of pyrene.