Novel magnetically separable nanomaterials for heterogeneous catalytic ozonation of phenol pollutant: NiFe$_2$O$_4$ and their performances

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**Highlights**

- Nano-sized NiFe$_2$O$_4$ were proposed as ozonation catalysts for the first time.
- The great difference between NiFe$_2$O$_4$–H and NiFe$_2$O$_4$–C was discussed.
- The vital role of the interaction between ozone and NiFe$_2$O$_4$ were investigated.
- Lewis acid sites and interfacial electron transfer were responsible for catalysis.

**Abstract**

Magnetic NiFe$_2$O$_4$ nanomaterials were proposed as novel ozonation catalysts for the first time. The samples which were synthesized by the hydrothermal method and the calcined method were dominated as NiFe$_2$O$_4$–H and NiFe$_2$O$_4$–C, respectively. Compared with ozonation alone, the presence of NiFe$_2$O$_4$–H significantly enhanced the degradation of phenol, while NiFe$_2$O$_4$–C was noneffective. The interaction between NiFe$_2$O$_4$–H and ozone was obviously stronger than that in ozonation/NiFe$_2$O$_4$–C. This interaction between catalyst and ozone was proved to be a surface process and played a vital role in the heterogeneous catalytic ozonation. Phosphate revealed significantly inhibitive influence on the decomposition of ozone and the degradation of phenol in ozonation/NiFe$_2$O$_4$. Lewis acid sites were proved as reactive centers for catalytic ozonation in aqueous solution. The results indicated that not only the more surface Lewis acid sites, causing the strong interaction between catalyst and ozone, but also the enhanced interfacial electron transfer lead to the higher catalytic activity of NiFe$_2$O$_4$–H than NiFe$_2$O$_4$–C. Furthermore, the NiFe$_2$O$_4$–H nanocatalyst could be easily and efficiently separated from the reaction mixture with an external magnet, which made it an attractive nanomaterial with prospective application in catalytic ozonation of organic pollutants in water treatment.