CNTs/ferrihydrite as a highly efficient heterogeneous Fenton catalyst: the important role of CNTs in accelerating Fe(III)/Fe(II) cycling

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The generation of Fe(II) from Fe(III) is the rate-limiting step in the heterogeneous Fenton reaction, and accelerating this step is critical for enhancing the reaction efficiency and also the subject of extensive studies [1, 2]. The strategies for accelerating the generation of Fe(II), therefore, are drawing particular concerns [3, 4].

In this work, the oxidized multi-walled carbon nanotubes (CNTs) were coupled with ferrihydrite (Fh) to synthesize novel and highly efficient heterogeneous Fenton catalysts (CNTs/Fh), and the underlying mechanism were well explored. Interestingly, the calculated apparent rate constants by 3%CNTs/Fh could reach ~7.1 times as high as that by Fh (Fig. 1a), well in agreement with the accelerated decomposition rate of H_2O_2, as well as the enhanced generation rate of Fe(II) and hydroxyl radicals in the CNTs/Fh system.

The density functional theory calculations and the cyclic voltammograms curves both well indicated that the Fe(III)/Fe(II) redox cycling on CNTs/Fh could be significantly enhanced during the Fenton reaction, from both dynamic (accelerating the electron transfer from H_2O_2 to Fh) and thermodynamic (lowering Fe(III)/Fe(II) redox potential) aspects (Fig. 1b).

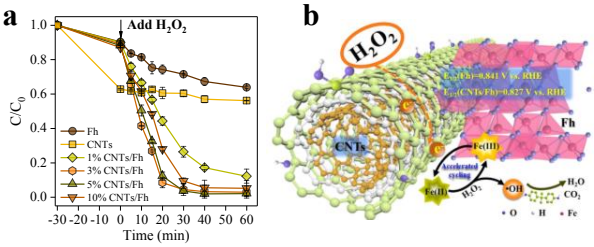

Fig.1 (a) Degradation kinetics for the degradation of BPA by as-prepared catalysts; (b) possible heterogeneous Fenton catalytic mechanism in the CNTs/Fh system.

[1] Hou et al. (2017) *Environ. Sci. Technol*. 51, 5118-5126. [2] Bolobajev et al. (2015) Chem. Eng. J. **281**, 566-574. [3] Qin et al. (2018) *Water Res*. **137**, 130-143. [4] Liu et al (2017) *Appl. Catal. B: Environ*. **206**, 642-652.