Black carbon as a rechargeable geobattery for microbial redox transformation

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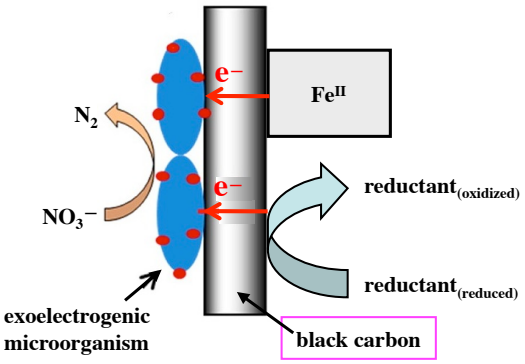
Black carbon is a carbonaceous component ubiquitous in natural environments. Black carbon has also been evaluated as adsorbent for water treatment, sediment remediation, and other engineering applications. We previously showed black carbon materials such as soot, graphite, and char are not merely chemically passive sorbents but redox-active catalysts that can mediate abiotic redox reactions [1]. Here, we further demonstrate that microorganisms can also take advantage of the redox properties of black carbon and utilize it as a rechargeable geobattery to support microbial electron transfer processes. A schematic diagram illustrating the proposed black carbon-mediated electron transfer transformation is shown below.



Experiments were conducted using a wood-based biochar prepared through slow pyrolysis at 550 ºC and *Geobacter metallireducens* as a model bacterium. Acetate was used as an electron donor and nitrate an electron acceptor. The ability and efficiency of the biochar to facilitate acetate oxidation and nitrate reduction were investigated through batch experiments carried out in an anaerobic glove box. Data will be presented that support of the hypothesis. The underlying mechanism through which black carbon facilitates microbial redox transformation will be presented. The environmental implications and potential engineering applications of the results will be discussed.

[1] Oh and Chiu (2009) *Environ. Sci. Technol.*, **43**, 6983-6988