

Magnetic Composite Effects on a Nickel
Electrocatalyst for Alcohol OxidationGarrett G. W. Lee[†], Johna Leddy[‡], and Shelley D.
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Alkaline fuel cells are efficient electrochemical energy devices, which readily achieve 50 to 60 % efficiency. However, platinum catalyzed AFCs require high purity molecular hydrogen as impurities such as CO₂/CO passivate the system. (1) Alternatives to platinum group metal electrocatalysts are sought. Nickel has garnered much attention; not only is the material more abundant and less expensive than platinum, direct reformation of aliphatic alcohols at nickel in alkaline has been demonstrated. Efforts to increase the catalyst loading density are ongoing. (2, 3)

Magnetic field effects have been demonstrated in a number of electrochemical systems and produce increased system efficiency. (4-6) These fields have been incorporated as both external fields, supplied by large permanent magnets (7), and as local fields, supplied by composites of micron scale ferromagnetic materials (4). Magnetic effects are theorized to arise through a variety of mechanisms, including kinetic effects on paramagnetic species, but more commonly as increased transport on the magnetic gradient, i.e., magnetohydrodynamics (8).

Here, we have applied local magnetic fields, supplied by a magnetic composite, to a traditional nickel electrocatalyst. The field is supplied by iron oxide microparticles, coated in a chemically and electrochemically inert shroud. The particles are immobilized on nickel-deposited carbon paper electrodes at ~15 % loading (v/v) within a high flux Nafion derivative, TBAB-Nafion.

When the magnetic composite is combined with the nickel-deposited electrode, we observe a statistical enhancement in the current response of methanol oxidation of 42 % at 0.65 V (vs. Ag|AgCl) and 28% at 0.7 V (vs. Ag|AgCl) for *n*-butanol. In addition, we see a statistical change in the ratio of nickel-to-fuel

oxidation in the presence of the magnetic composite. Here, the nickel oxidation peak (not pictured) is used as internal standard for nickel content per electrode.

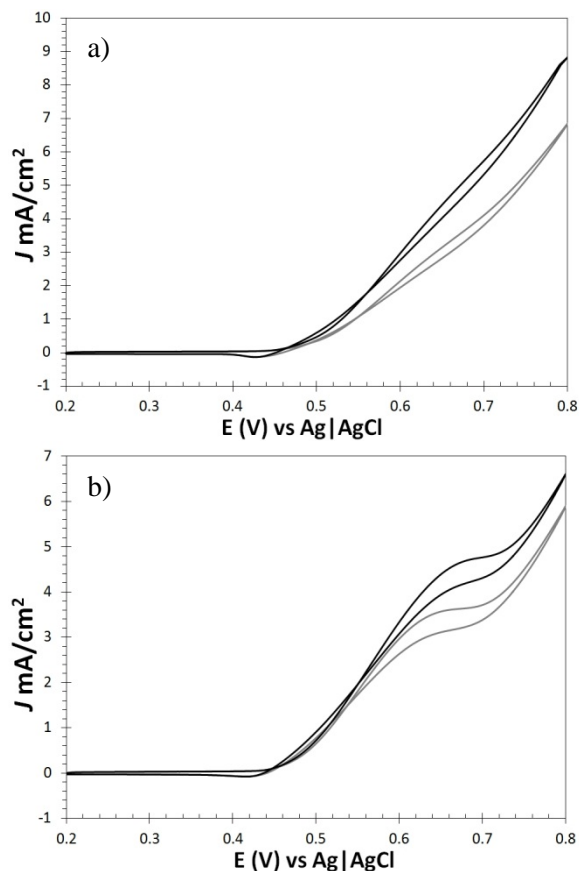


Figure. CVs (IUPAC) of fuel oxidation at nickel electrocatalyst, control (gray) and with magnetic composite (black), $v = 0.05$ V/s, 0.1 M NaOH aq.; a. 1 M methanol, b. 0.5 M *n*-butanol

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