

Electrochemistry of Ferrocene-Tethered
Surfactants at Clay Surfaces

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Cation exchange with organics has long been utilized to change the nature of the clay to produce desirable characteristics and to provide insight into clay structure and reactivity. In particular, the clay interlayer region can be modified and exploited as a site for reactions to occur that may not occur in bulk solution. We have synthesized and employed a series of ferrocene-containing surfactants to probe this region. These surfactants have a trimethylammonium headgroup that interacts electrostatically with the clay. On the other end is a ferrocene group attached via a hydrocarbon chain containing one, six, or eleven carbon units.

When these surfactants come into contact with the clay, interesting behaviors are noted, both visually as composites in suspension and electrochemically as thin-layer films. In clay suspension, the ferrocenyl surfactants with longer chain lengths are oxidized to ferrocenium. Several factors may contribute to this effect, including chain length and positioning of the ferrocene in relation to the clay, redox activity of Fe within the clay lattice, and acidity of the edge sites and interlayer region. As observed by cyclic voltammetry, these surfactants generate a capacitive current at high loading in a thin clay film, implying that an electron hopping mechanism is occurring. Characterization of these systems based on electrochemistry, UV-Vis, and IR will be presented.