From microelectrode arrays to the processing of lignin derived materials: Using electrochemistry to solve synthetic problems of structure and location.

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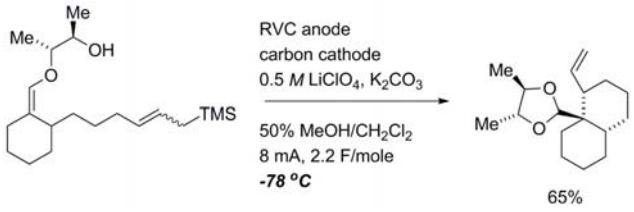
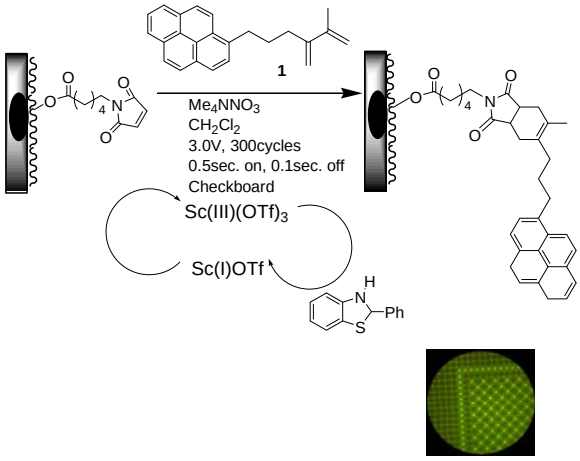
Organic electrochemistry is a powerful tool for conducting a wide variety of oxidation and reduction reactions. It allows for the generation of highly reactive intermediates and the initiation of interesting new umpolung reactions (Scheme 1), the confinement of chemical reactions to site-specific sites on microelectrodes arrays that have over 12,000 electrodes/cm^2 (Scheme 2), and the recycling of chemical reagents in a manner that is both atom and energy economical (Scheme 3). The application of electrochemistry to this set of diverse problems is straight forward since the reaction setups and the principles used to govern the outcome of the reactions are the same in each case. In every example, a constant current electrolysis is used so that the potential at the electrode automatically adjusts to that of the substrate. The method allows for the use of any source of electricity to drive the oxidation of substrates having a wide variety of oxidation potentials. In this way, structure activity studies can be conducted on reactive radical ion intermediates originating from a variety of substrates using identical reaction conditions, and sustainable approaches for conducting a wide variety of oxidation and reduction reactions can be designed in a simple, straight forward manner.

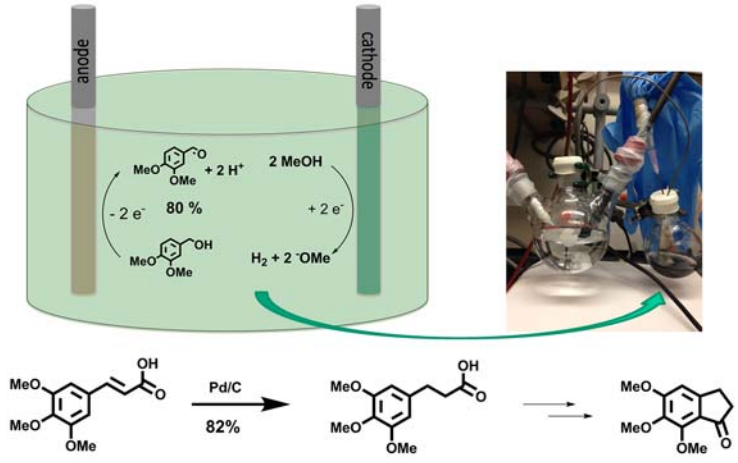
Scheme 1



Scheme 2. Sc(III) catalyzed Diels-Alder reaction.



Scheme 3



The talk presented will highlight the synthetic utility of electrochemistry, as well as discuss the mechanistic principles that allow organic chemists to take full advantage of the technique.