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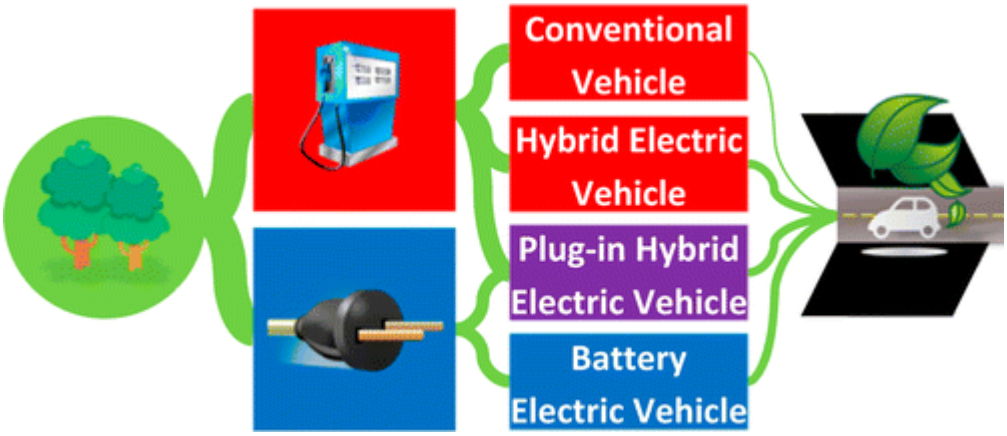
FACULTY OF APPLIED SCIENCE & ENGINEERING
Institute for Sustainable Energy

2013 Institute for Sustainable Energy Outstanding Energy Paper Awards

Jason M. Luk, Mohammad Pourbafrani, Bradley A. Saville and Heather L. MacLean

Ethanol or Bioelectricity? Life Cycle Assessment of Lignocellulosic Bioenergy Use in Light-Duty Vehicles

Environmental Science & Technology 2013, **47**, 10676−10684
http://dx.doi.org/10.1021/es4006459



In the transportation sector over 97% of energy use can be attributed to petroleum. As the automobile industry explores bioenergy as an alternative supply, the comparative advantages of liquid biofuel (lignocellulosic fuels) and bioelectricity demand greater attention. Lead-author **Jason Luk** (Civil), a PhD candidate, in Prof. Heather MacLean's research group employs a life-cycle analysis modelling well-to-pump, pump-to-wheel, and vehicle cycle stages for a range of vehicles including Hybrid Electric, Plug-in Hybrid, Battery Electric, and Conventional vehicles. The study finds that while both biofuel and bioelectricity have comparable impact on GHG emissions, regional characteristics may still create conditions under which either may be superior.

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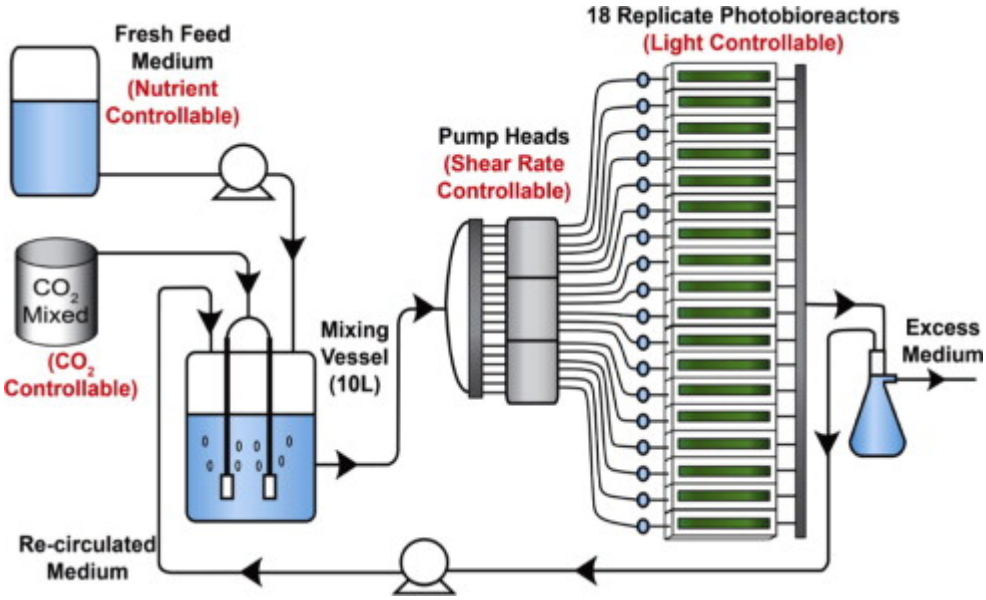
Peter J. Schnurr, George S. Espie, D. Grant Allen

Algae biofilm growth and the potential to stimulate lipid accumulation through nutrient starvation

Bioresource Technology 2013, **136**, 337–344
http://dx.doi.org/10.1016/j.biortech.2013.03.036



With rapid growth and dense lipid/oil concentrations biofuels derived from algae have seen a surge in interest as a viable biofuel stock, with numerous advantages over fuels derived from corn, soybean, and other plants. Lead author **Peter J. Schnurr**, a graduate student in the Dept. of Chemical Engineering & Applied Chemistry working with Prof. Grant Allen and Prof. George Espie, has developed an algae biofilm growth system which allows him to study the growth kinetics and neutral lipid productivities of specific algae. While the system further enables him to limit key nutrients to algal biofilms, the study shows this method of nutrient starvation is not an effective method of lipid production. The biofilm growth system does however demonstrate very favorable lipid productivities in comparison to conventional algae crops.

Tyler B. Schon , Paul M. DiCarmine , and Dwight S. Seferos

Polyfullerene Electrodes for High Power Supercapacitors

Advanced Energy Materials 2013
http://dx.doi.org/10.1002/aenm.201301509

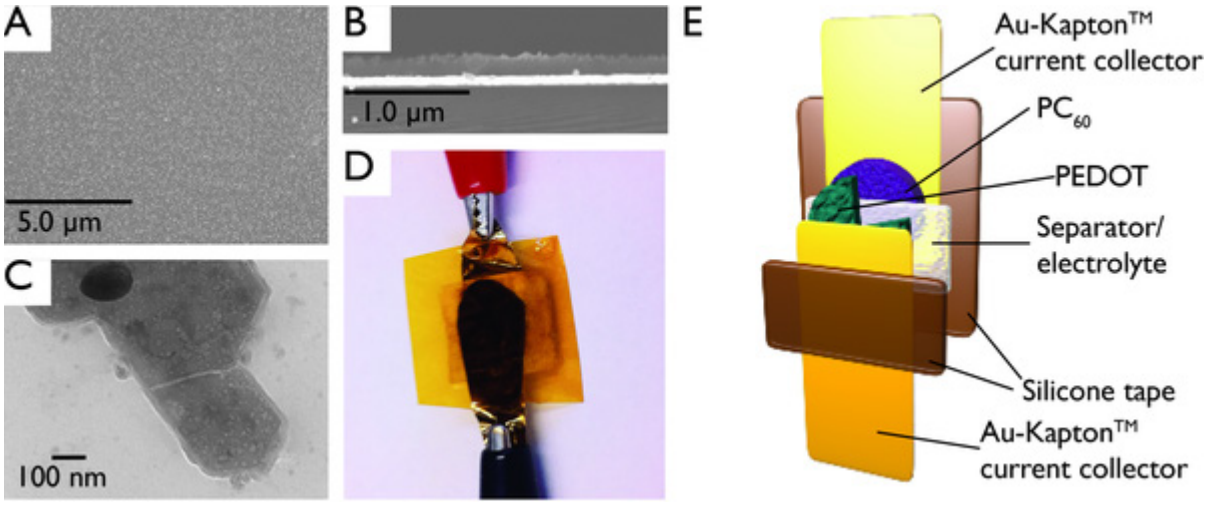


Figure 1. A) Top-view and B) cross-sectional SEM image of the electropolymerized PC_{60} polymer. C) TEM image of the PC_{60} polymer deposited from an ethanol suspension. D) Photograph of the assembled SC with electrical connections and E) schematic of the assembled SC. The PEDOT electrode is partially cut away for clarity.

Battery-powered electronic devices have an increasingly large role in our day to day lives, and with this reliance comes a desire that batteries be smaller, recharge faster, and have a longer life-span. By integrating batteries with supercapacitors (SC) we may be getting closer to the kinds of efficiencies we require. Lead author **Tyler Schonn** (Chemistry), together with Paul DiCarmine and Prof. Dwight Seferos are looking at highly capacitive fullerene polymers to act as negative charge-accepting electrodes in a supercapacitor. Most SC are limited to positive charge-accepting materials that are only stable in neutral or positively charged states thus diminishing the operating potential, energy and power of the device. By enabling a negative charge-accepting material the study highlights the potential for supercapacitors to greatly increase their operating potential.

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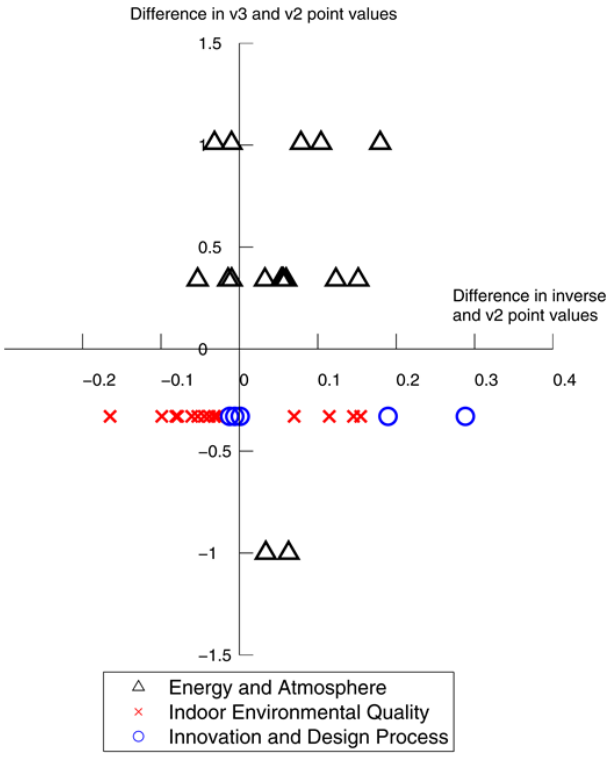
Sarina Turner, Timothy Chan

Examining the LEED Rating System Using Inverse Optimization

Journal of Solar Energy Engineering, 2013, **135(4)**, 040901
http://dx.doi.org/10.1115/1.4025221



A comparison of point value changes suggested by inverse optimization and LEED version 3

In North America, the most recognized certification program for green building is the Leadership in Energy and Environmental Design (LEED) rating system, now in its 3rd iteration. While builders previously received single credits for design elements, regardless of cost or environmental impact, version 3 introduced a weighting to credits for certain design elements that achieved greater energy efficiency and CO2 reduction. Lead author **Sarina Turner** (MIE), and Prof. Timothy Chan have taken an inverse optimization approach to study the effects of weighted credits and their impact on criticisms in versions 1 and 2 that builders 'point chased' by incorporating the easiest and cheapest design elements to meet minimum thresholds. The study finds that builders have not placed equal value on all credits, particularly when factors such as cost, building type, size, and certification level play a role in how the credits are valued.
