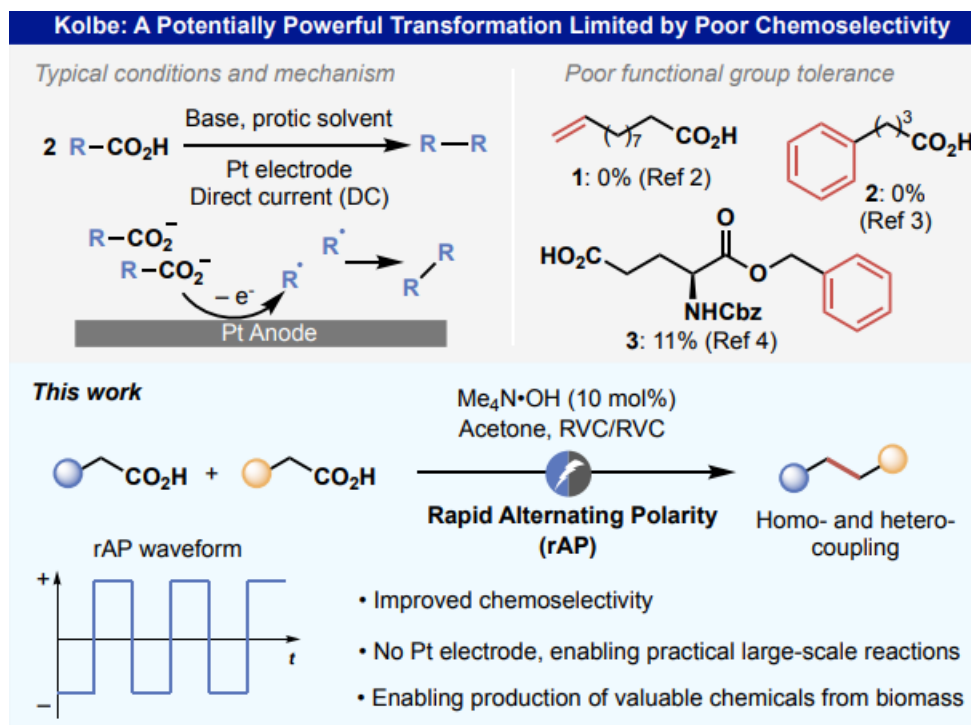


Overcoming the Limitations of Kolbe Coupling via Waveform-Controlled Electrosynthesis

Hioki, Y.; Costantini, M.; Griffin, J.; Harper, K.; Merini, M. P.; Nissl, B.; Kawamata, Y.; Baran, P. Overcoming the Limitations of Kolbe Coupling via Waveform-Controlled Electrosynthesis. 2022. <https://doi.org/10.26434/chemrxiv-2022-3cj82-v2>.



Who are the corresponding authors and what are their research areas?

Phil S. Baran - Professor in the Department of Chemistry at the Scripps Research Institute and Member of the Skaggs Institute for Chemical Biology.

Baran has authored over 130 published scientific articles. He has several patents. His work is focused on synthesizing complex organic compounds, the development of new reactions, and the development of new reagents.

What is the main claim of the article?

In this article, Baran's group represented a simple solution to the long-standing challenge of the Kolbe reaction poor chemoselectivity and reliance on precious metal-based electrodes. It is presented by merely tuning the waveform employed, leading to the tolerance of a broad range of functional groups using inexpensive and sustainable carbon-based electrodes. Surprisingly, the reactivity change could be the result of the local acidity difference at the anode surface during different waveforms.

How is it demonstrated?

To demonstrate, switching from classic direct current (DC) to rapid alternating polarity (rAP) leads to the observation of Kolbe dimers and heterocoupling products with no racemization. Electrogenerated acidity around the anode during DC electrolysis leads to electrode passivation or oxidation of other functional groups outcompetes decarboxylative processes. However, using rAP, this phenomenon is not observed due to rapid oscillations.

Using ^1H NMR, ^{13}C NMR, HRMS (ESI-TOF) and TLC, they were able to detect the products of the reaction. HPLC studies were performed for the confirmation of no racemization of the Kolbe heterocoupling. Cyclic voltammetry studies were carried out to explain observed chemoselectivity.

What are the typical experimental conditions?

Tetramethyl ammonium hydroxide $\text{Me}_4\text{N}\cdot\text{OH}$ was used as a base, acetone as a solvent, along with carbon-based electrodes (RVC, reticulated vitreous carbon). Electrolysis parameters: constant current: 60 mA, Alternating frequency: 50 ms (10 Hz), amount of charge: 8 F/mol. Reagents were used in mmol quantities.

Which are the key related papers?

1. M. Yan, Y. Kawamata, P. S. Baran, *Synthetic Organic Electrochemical Methods Since 2000: On the Verge of a Renaissance*. *Chem. Rev.* **2017**, *117*, 13230–13319.
2. M. Quertenmont, I. Goodall, K. Lam, I. Markó, O. Riant, Kolbe Anodic Decarboxylation as a Green Way to Access 2-Pyrrolidinones. *Org. Lett.* **2020**, *22*, 1771–1775.
3. B. Zhang, Y. Gao, Y. Hioki, M. S. Oderinde, J. X. Qiao, K. X. Rodriguez, H.-J. Zhang, Y. Kawamata, P. S. Baran, Ni-Electrocatalytic Csp^3 – Csp^3 Doubly Decarboxylative Coupling. *Nature* **2022**, *606*, 313–318.