The Electro-Inductive Effect

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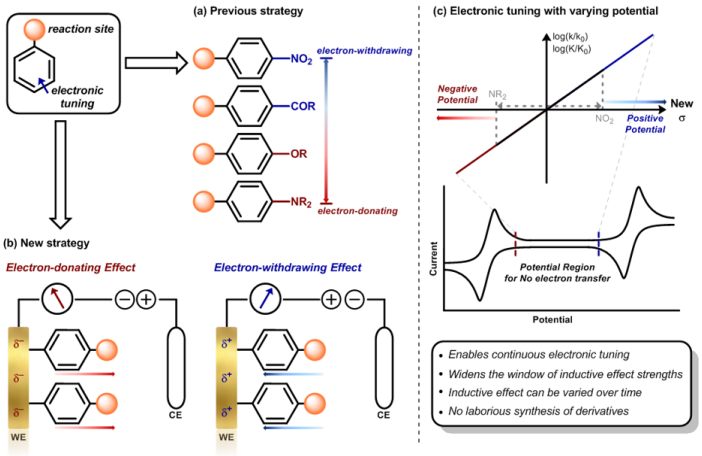
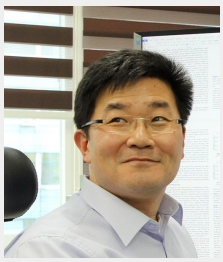
The electro-inductive effect offers a novel approach to modulating the chemical properties of molecules without the need for labor-intensive synthesis of derivatives with varying functional groups. By transmitting voltage-induced charge polarization from an electrode to molecules covalently attached to its surface, this method mimics the inductive effect of functional groups. Proof-of-concept studies with self-assembled monolayers of thiols on gold electrodes have demonstrated the potential of this technique for reaction control. However, such demonstrations have so far been limited to single-molecule scales.

Recently, we demonstrated that the electro-inductive effect can fine-tune the catalytic behavior of arylsulfonic acid immobilized on porous carbon electrodes for Brønsted acid-catalyzed organic reactions at millimolar scales. Applying voltages between –0.9 V and +0.8 V relative to the open circuit voltage modulated the yield of acid-catalyzed esterification by a factor of ~3. Furthermore, in the intramolecular nucleophilic substitution of an alcohol bound to a chiral carbon, the stereochemical outcome of carbocyclization was altered by adjusting the applied voltage. These results establish the electro-inductive effect as a scalable alternative to functional group modification for controlling catalytic organic reactions at practically relevant scales.





Mu-Hyun Baiki *is an associate director of Korea Advanced Institute of Science and Technology (KAIST). He is a professor of chemistry at KAIST and is a renown computational chemist and an expert in analyzing complicated chemical reactions to understand how molecules behave and how they change. Professor Baik is a firm believer in teamwork and emphasizes collaborative research efforts among scientists from different disciplines as a key component of success. He obtain B.Sc. at the University of Dusseldorf (Germany) in 1995 and PhD degree in USA at Indiana University in 2000. For many years he worked in USA and UK. First as a postdoctoral fellow with prof. Rich Frienser at Columbia University (2000-2003), research fellow with prof. Jenny Green at Oxford University (2003), and assistant professor (2003-2008) and associate professor (2008-2015) at Indiana University. He has been employed at KAIST since 2015, now being an Associate Director, CCHF-IBS and Professor, KAIST. His research is focused on computational chemistry, reaction mechanisms, electronic structures, transition-metal catalyzed reactions and electron-inductive effect.*
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He published more than 280 articles in e.g., JACS, Angew. Chem. Int. Ed., Science, Nature Communications, Adv. Mater., ACS Catalysis, which were cited almost 12 300 times. His h-index is 63 (based on Scopus).