

Practical and Mechanistic Aspects of Electrochemically- Induced Reactions of Fullerenes

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The discovery of electrochemically-induced reactions of malonate derivatives of C₆₀ opened up a new line of research a few years ago. We discovered that bis-malonate adducts (*Bingel* adducts) can be electrochemically isomerized *via* what we believe is a "walk-on-the-sphere" mechanism to yield a unique isomer distribution, with a predominance of the *trans*-2 (and *trans*-1) isomers. If the electrolyses are conducted further, the malonate adducts are eventually removed from the C₆₀ sphere, in a process we have described as the *retro-Bingel* reaction. Several uses for this reaction have already been published, most notably for the separation and purification of constitutional isomers and enantiomeric forms of the higher fullerenes, C₇₆ and C₈₄. New results using mixed bis-adducts show that it is possible to remove the *Bingel* adducts selectively, leaving other groups unperturbed on the carbon sphere. Real synthetic applications have recently appeared which are derived from these observations.

Non-*Bingel* adducts have been investigated recently and some have been found to be electrochemically unstable. In some cases it is also possible to remove these adducts quantitatively to give high yields of C₆₀ while in THF they can yield intermolecular products, thus bis-adducts can form electrochemically from a starting mon-adduct. Electrochemical simulations and product analysis have been conducted to understand the mechanistic details of these reactions and their potential use in fullerene derivative syntheses.