REMARKS ON BENIGN SYNTHETIC ROUTES BY ELECTROCHEMISTRY

M. Michman

The Hebrew University of Jerusalem, Jerusalem, 91904 Israel

michman@cc.huji.ac.il

Electrochemistry is occasionally praised as an environmentally benign method of chemical synthesis since it is based on the *electron as a clean reagent*. Is electrochemistry a suitable *green* method or are other *colours* involved? Two examples are discussed as compared to alternative detrimental routes:

1 Oxidation with reduced oxygen (1).

Oxidation with reduced oxygen provides an example whereby a compound used for medication *probenecid* typically contains a carboxylic function to assist water solubility. Reported preparations have involved substitution of benzoates with adverse reagents. The oxidation of toluene derivatives by electro-reduced oxygen provides a benign procedure.

2 Ruthenium based electro-catalytic aromatic oxidation (2,3).

Substitution of aggressive oxidation (as in chromic acid or high-pressure cobalt catalyzed procedures) by indirect electrolysis offers *green* opportunities.

Further significant incentives include: high safety, nullifying the need of high pressures and temperature, reducing the risk of runaway reactions and excellent on-off control. Another advantage is the suitability for designing flow processes instead of batch procedures.

The vicious circle, -even in successful electrosynthesis, is the high value of the *Faraday* constant, considerable energy cost in low voltage DC transfers, and effluent treatment of electrolyte solutions.

All considered, possible candidates for electrochemical green processes should perhaps be based on solar energized, slow-rate continuous reactions.

1. Selective electrooxidation of 4-(di-n-propylsulfamyl)toluene, M. Michman and M. Weiss, *Studies in Surface Science and Catalysis*, (G. Centi and F. Trifino Eds.), Elsevier, 1989, 667-673.

2. The Indirect Anodic Oxidation of 2-Methylnaphthalene Part 2, Oxidation in presence of dichromate. S. Chocron and M. Michman, *J. Mol. Catal.* **83**, 251- 259, (1993).

3. $Ru(CH_3CN)_3Cl_3$, preparation and use as a mediator for the electrooxidation of hydrocarbons, L. Appelbaum, C. Heinrichs, J. Dehmtschuk, M. Michman, M. Oron, H.J. Schäfer and H. Schumann, *J. Organomet. Chem.* **592**/2 240-250 (1999).