

ELECTROCHEMICAL TRANSCARBONATION: HYDROQUINOXY CARBONYL

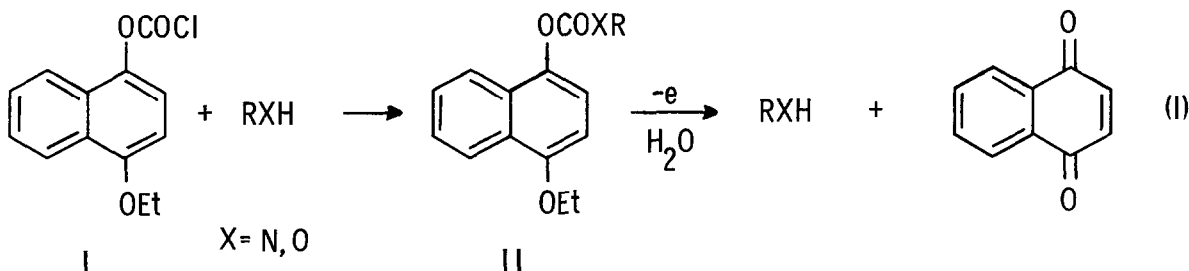
PROTECTING GROUP FOR ALCOHOLS AND AMINES

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Abstract: An electrochemically labile protecting group for alcohols and amines is reported. It can be removed under acidic or basic conditions and at low temperatures.

Protecting groups for alcohols and amines continue to be of interest, as the restrictions placed upon them become more severe due to the high degree of functionalization of the synthetic targets.¹ We describe here our hydroquinoxy carbonyl protecting group which is removed by an anodic oxidation. The electrochemical cleavage reaction should make this group quite versatile, since oxidation at one electrode is selective for the desired electrophore and can be performed under mild and variable conditions.²

Based on our previous work with hydroquinone esters,³ we felt that anodic transcarbonation to water would be an effective method for hydrolysing carbonates or ureas and thereby liberating protected alcohols or amines, eq. 1. To satisfy the constraints of redox potential and synthetic viability, we considered various hydroquinone derivatives, and have found 4-ethoxy-1-naphthyl chloroformate, I, to be the reagent of choice.⁴ It is readily prepared from the corresponding naphthol⁴ by treatment with phosgene. Alcohols and amines are easily derivatized using DMAP as catalyst, eq. 1, and the adducts can be purified by chromatography or recrystallization, Table I. All of these naphthhydroquinone derivatives undergo an irreversible oxidation around 1.60 V vs. s.c.e. as measured by cyclic voltammetry. For comparison, analogous benzhydroquinone derivatives oxidize around +1.85 V.



Preparative scale oxidation in aqueous acetone results in a very clean removal of the protecting group, Table I, and the naphthoquinone byproduct can be removed by extraction with basic hydrosulfite. In general, the oxidation is performed in an open beaker at a carbon felt anode as described previously, and controlled current oxidation using a standard DC power supply is adequate. Urethanes must be oxidized in an acidic medium to prevent oxidation of the

resulting amine,⁵ but carbonates can be cleaved under acidic or basic conditions. The oxidations can also be performed at low temperature. With regard to chemical oxidation, ceric ammonium nitrate can serve as an oxidant, but the yields are much lower.

Table I

RX	II % ^b	Oxidation % ^b	Conditions
Benzyl alcohol	70	86	NaHCO ₃
		93	
		86	-20°C
Borneol	75%	84	
		4	Ce(IV) oxidant
Geraniol	70	67	
Methylbenzyl amine	90	80 ^c	HClO ₄

^aYield of purified material based on I, alcohol in excess, conditions not optimized.

^bYields determined by gas chromatography, 15% carbowax on chromasorb P.

^cYield measured after conversion to trifluoroacetamide.

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References

- 1) For a recent review of protecting groups, see T. Green, Ph.D. dissertation, Harvard University.
- 2) For a review of other electronically labile protecting groups, see: V. Mairanovsky, *Angew. Chem. Int. Ed.*, **15**, 281 (1976).
- 3) R. W. Johnson, M. Bednarski, B. O'Leary, and E. R. Grover, preceding paper.
- 4) Since beginning work on 4-ethoxy-1-naphthol, a paper has appeared which makes other derivatives, including methyl, readily available: H. Laatsch, *Justus Liebigs. Ann. Chem.*, 140 (1980).
- 5) Amines with high p^KB's, i.e. aniline, are not protected from oxidation by this technique.

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