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Electrochemical Oxidation of Chiral 5-Substituted 2-Oxazolidinones: A Key Building Block for Dichiral β-Amino Alcohols

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Abstract: The 4-methoxylation of some chiral 5-substituted 2-oxazolidinones can be performed successfully by direct electrochemical oxidation at 50 mA/cm^2 in methanol at graphite electrodes using an undivided or quasi-divided cell and sodium tetrafluoroborate or sodium benzene sulfonate as supporting electrolytes. The yields and selectivities are depending on the pH of the solution and the concentration of the substrate. Thus, (*4RS,5S*)-chloromethyl-4-methoxy-2-oxazolidinone (**7**) could be obtained in 76% yield from (5S)-chloromethyl-2-oxazolidinone (**3**). Through nucleophilic methoxy-group exchange these heterocycles are key intermediates for enantiomerically pure *trans*-4,5-difunctionalized-2-oxazolidinones in both enantiomeric forms, which are very interesting targets due to their various pharmacological effects and as precursors for β-amino alcohols and protease inhibitors.

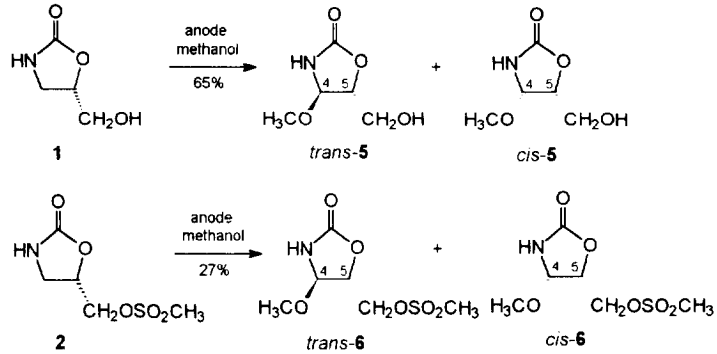
INTRODUCTION

The oxidation of amides and carbamates to the corresponding α-oxy-compounds is a very important reaction since α-oxy-amides and carbamates are valuable precursors for *N*-acyl iminium ions as amidoalkylation reagents. Beside very few chemical procedures there are three different electrochemical methods for the generation of these important building blocks depending on the structure of the starting material: 1. direct oxidation of simple amides and carbamates[1-12], 2. indirect oxidation of amides and carbamates with electron withdrawing groups in α-position[4a,b,13], and 3. Hofer-Moest methoxylative decarboxylation[4a,b,14] of α-amino acids. We were interested in the 4-methoxylation of some chiral 5-substituted 2-oxazolidinones by direct electrochemical oxidation. The heterocyclic products are stable forms of chiral *N*-acyl iminium ions as building blocks for the formation of dichiral enantiomerically pure 4,5-difunctionalized-2-oxazolidinones, which are very interesting targets due to their various pharmacological effects[15-18] and as precursors for β-amino alcohols.

RESULTS AND DISCUSSION

As substrates we selected the chiral 5-hydroxymethyl-2-oxazolidinone (**1**) and its derivatives 5-methansulfonyloxymethyl-2-oxazolidinone (**2**), 5-chloromethyl-2-oxazolidinone (**3**), and 5-bromomethyl-2-oxazolidinone (**4**). These compounds are readily available in both enantiomerically pure forms starting from D-mannitol, L-ascorbic acid, or D- or L-malic acid as we have described earlier[19].

The oxidation of **1** to 5-hydroxymethyl-4-methoxy-2-oxazolidinone (**5**) in an undivided cell (12 mL) with graphite anode and cathode of equal surface area (conditions: No. I, Table 1) proceeds at r.t. in 65 % yield in a *trans/cis* ratio of 8:1. Unfortunately, **5** is unstable presumably because of intermolecular nucleophilic substitution of the methoxy group by the hydroxy function via the *N*-acyl iminium ion. The oxidation of 5-methanesulfonyloxymethyl-2-oxazolidinone **2**, a protected form of **1**, leads to 5-methanesulfonyloxymethyl-4-methoxy-2-oxazolidinone **6** (27 %, *trans:cis* = 4:1; same conditions) which is also unstable.



Scheme 1: Direct anodic oxidation of 5-substituted-2-oxazolidinones **1** and **2** to give **5** and **6**

Table 1: Conditions and results of the direct electrochemical oxidation of **1** to give **5** and of **2** to give **6**

No.	Substrate	Current Density [mA/cm2]	Supporting Electrolyte	F/mol	Conc. of Substrate [mol/L]	Yield [%]	*trans* : *cis*
I	**1**	50	$NaBF_4$ (0.1 M in MeOH)	5.3	0.7	65 (**5**)	8 : 1
II	**2**	50	$NaBF_4$ (0.1 M in MeOH)	5.3	0.4	27 (**6**)	4 : 1

Due to their instability, products **5** and **6** are not attractive amidoalkylation reagents. Therefore, as an alternative we performed the electrochemical methoxylation of 5-chloromethyl-2-oxazolidinone (**3**) to give its 4-methoxy derivative **7** as a stable and valuable chiral building block. To optimize the reaction, we studied the influence of the supporting electrolyte, the cell type, the pH, the electrode material, and the concentration of starting material on the yields and the types of products.

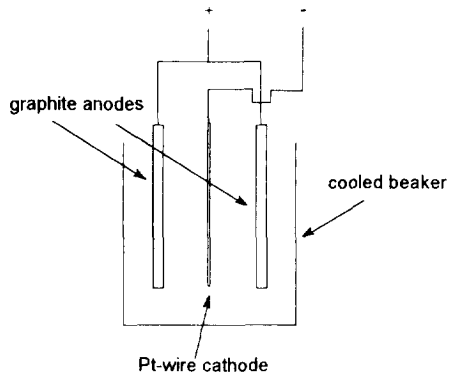
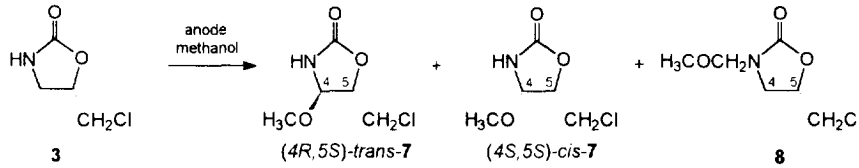


Figure 1: Quasi-divided cell

First we studied the influence of the cell type using a divided cell (anode compartment 25 mL, cathode compartment 6 mL) and an undivided cell. However, in contrast to the reactions reported in Table 1 for compounds **1** and **2**, we choose instead of an undivided cell with anode and cathode of equal surface area a so-called quasi-divided cell with a small Pt-wire cathode between two graphite-anodes (Figure 1). This cell type has the advantage that the high current density at the cathode favors the reduction of the solvent and avoids the reduction of the starting material. The anodic oxidation of (5*S*)-**3** in the quasi-divided cell leads to (*4R,5S*)-*trans*- and (*4S,5S*)-*cis*-5-chloromethyl-4-methoxy-2-oxazolidinone (**7**, 28%)) and only traces of **8**. In the divided cell, however, besides small amounts of **7** (4-5%) mainly product **8** (51%) is formed (Table 2).



Scheme 2: Direct anodic oxidation of 5-chloromethyl-2-oxazolidinone (**3**) to give **7** (*trans*:*cis*: 5 : 1) and **8**

Table 2: Influence of the cell type on the yield and ratio of products **7** and **8** during the anodic oxidation of **3**

No.	Cell Type	Current Density [mA/cm^2]	Supporting Electrolyte	F/mol	Conc. of Substrate [mol/L]	Anode Material	Cathode Material	Yield **7+8** [%]	**7** : **8**
III	quasi-divided (12 mL)	50	$NaBF_4$	4	0.18	graphite	Pt	28	1 : 0
VII	divided (25 mL/6 mL)	40	$NaBF_4$	5	0.18	graphite	Pt	55	1 : 12

Both products are stable for some days in the refrigirator and are easy to handle. The formation of **8** can easily be explained by the change of the solvent pH during the course of the electrolyses in the divided and quasi-divided cells as shown in Figure 2.

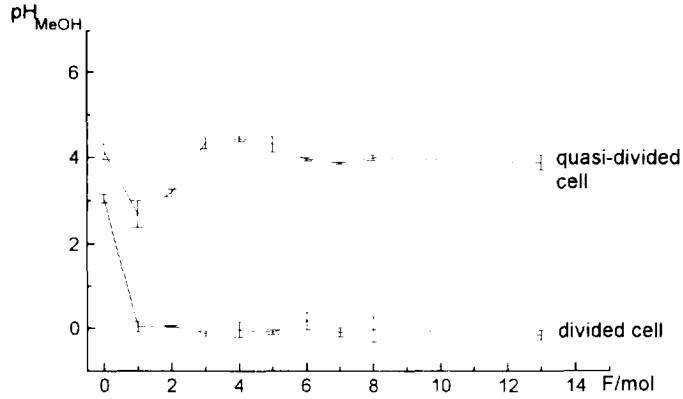
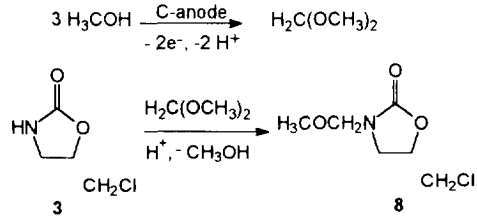


Figure 2: Change in pH_{MeOH} during electrolysis of **3** in MeOH/$NaBF_4$ using a quasi-divided or a divided cell

While in the undivided (quasi-divided) cell the pH of the solvent does not change very much during electrolysis, in the divided cell the pH of the solvent drops to very acidic values, as expected. Thus, the formation of **8** can be explained by the acid catalyzed reaction of **3** with the anodically formed formaldehyde dimethyl acetal generated through methanol oxidation (Scheme 3). Thus, by using an undivided or quasi-divided cell, the anodic oxidation of **3** can be performed selectively to give **7**.

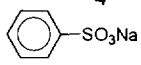


Scheme 3: Assumed mechanism for the formation of product **8** in the oxidation of **3**

We then studied the influence of the supporting electrolyte on the anodic oxidation of **3** to give **7** always using a quasi-divided cell of 12 mL volume (Table 3).

The differences in the yield can again mainly be explained by the different proton activities (pH_{MeOH}[20]) of the supporting electrolytes[21] during electrolyses of **3** in a quasi-divided cell using different supporting electrolytes: **A**: $NaBF_4$; **B**: sodium benzene sulfonate:**C**: KF. The pH_{MeOH} of sodium camphersulfonate after 1F/mol is 11.6. Each point was measured four times using a pH-electrode; the electrode was calibrated after each measurement with aqueous solutions of pH = 4 and 7;. the standard deviations are indicated by the bars; conc. of starting material: 0.05 mol/L.

Table3: Influence of the supporting electrolyte on the result of the electrochemical oxidation of **3** to give **7**

No.	Current Density [mA/cm2]	Supporting Electrolyte	F/mol	Conc. of Substrate [mol/L]	Anode Material	Cathode Material	Yield of **7** [%]
III	50	$NaBF_4$	4	0.18	graphite	Pt	28
IV	50		4	0.18	graphite	Pt	37
V	50	KF	4	0.18	graphite	Pt	23
VI	50	sodium campher sulfonat.	4	0.18	graphite	Pt	7.5

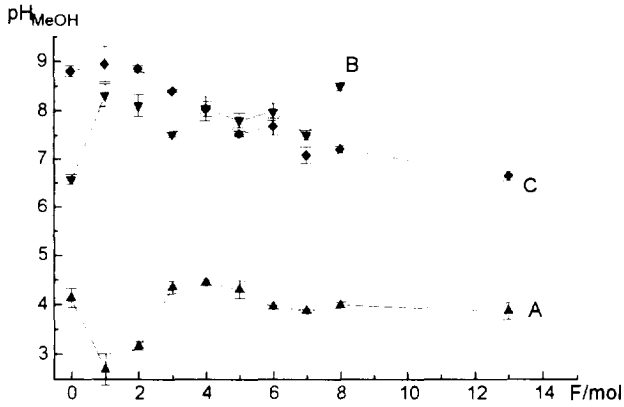


Figure 3: Change of pH_{MeOH} during the electrolysis of **3** using different supporting electrolytes

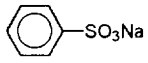
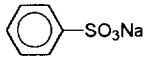
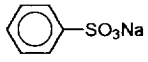
Apparently, it is of advantage to use a pH_{MeOH} of about 8-9 (sodium benzene sulfonate). At lower pH_{MeOH} ($NaBF_4$) and also at lower proton activity (sodium camphersulfonate, pH_{MeOH} 11.6) the yields decreased considerably. Especially, at basic pH values the methanol oxidation is favored. The results with KF as supporting electrolyte may be explained by the strong solvation of the fluoride ion by the solvent leading to predominant methanol oxidation. To obtain higher yields than about 40% it seems to be necessary to suppress the interfering oxidation of methanol.

It must be mentioned at this point that the pretreatment of the graphite electrodes also has a remarkable influence on the pH_{MeOH} of the electrolyte. To study this effect, the pH_{MeOH} was followed during electrolyses of **3** at 0.05 mol/L in methanol containing sodium benzene sulfonate (0.1 M) at -10° C in a quasi-divided cell using graphite anodes and a platinum wire cathode. Three methods of pretreatment for the graphite anodes were employed: A: 5 min ultrasound in aceton followed by 5 min ultrasound in methanol and 5 min ultrasound in methanol p.a.; B: stirring with a solution of sodium methanolate (2 g; 15 min) in methanol followed by washing with methanol; C: only washing with methanol. Condition A is the standard pretreatment and the result is reprorted in Figure 3, curve B. The pH_{MeOH} increases fast from 7 to 8 and then stays

constant. Under condition B, the pH_{MeOH} increases from 8 to 10 and then drops very slowly to about 9. Under condition C, the pH_{MeOH} raises fast from 3.5 to 6 and then increases very slowly to 6.5. The strong influence of the pretreatment of the electrodes on the pH_{MeOH}, which can even overcompensate the influence of supporting-electrolyte, may be rationalized by the structure of the surface of the graphite electrode[22,23] which contains acidic surface oxides. The pH_{MeOH} then depends on the amount of neutralization of the surface oxides. Conditions A and B with more basic pH_{MeOH} are favorable for the elctrolysis of **3**.

The use of an electrode with a higher hydrophobicity should partially suppress the methanol oxidation. Such electrodes are discribed by Beck et al.[24] They are composed of a mixture of polypropylene (PP) and carbon black (25 %). Unfortunately, these electrodes have a very high resistance. Hence, a scale-up to larger amounts of starting material was not possible due to contacting problems with larger electrodes. The results of the comparison between different electrode materials is shown in Table 4.

Table 4: Influence of different electrode materials on the anodic oxidation of **3**.

No.	Cell Type	Current Density [mA/cm^2]	Supporting Electrolyte	F/mol	Conc. of Substrate [mol/L]	Anode Material	Cathode Material	Yield of **7** [%]
IV	quasi-divided (12 mL)	50		4	0.18	C	Pt	37
X	undivided (12 mL)	50		3	0.19	PP	Pt	38
XI	quasi-divided (12 mL)	50		4	0.18	Pt	Pt	29

At platinum anodes very often methanol oxidation is favored in direct oxidations. To overcome this problem, the use of graphite-electrodes[4a,4c,8,9,12d,25,26] is of advantage. This is also demonstrated in our case. The more hydrophobic carbon black filled polypropylene electrode led to slightly better results. But the yields are still not satisfactory.

Another possible way to suppress the solvent oxidation is the use of higher concentrations of substrate. Therefore, we studied the influence of the concentration of **3** on the yield of **7** (quasi-devided cell (12 mL, 50mA/cm^2 current density, sodium benzene sulfonate as supporting electrolyte; Table 5, Figure 4).

Table 5: Influence of the concentration of **3** on the anodic formation of **7** (*saturated solution) .

No.	F/mol	Conc. of Substrate[mol/L]	Anode Material	Cathode Material	Yield of **7** [%]
IV	4	0.18	C	Pt	37
XII	4	1.08	C	Pt	43
XIII	4	1.48	C	Pt	60
XIV	4	2.53*	C	Pt	76

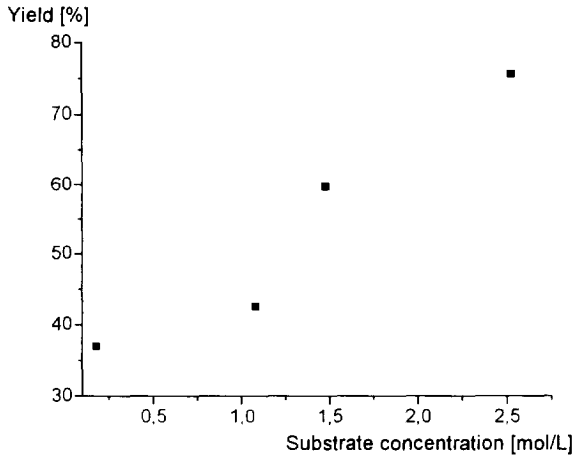
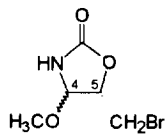


Figure 4: Influence of the substrate concentration

The yield of 76 % of **7** in the direct oxidation of **3** in experiment No. XIV is remarkable. Under the conditions of a saturated concentration of **3** like in XIV, we performed the electrolysis once with 12 g and once with 1 g of substrate. The yield of 76% was the same in both cases. Thus, the result is due to the concentration and not to the scale of the experiment. The explanation of this effect is not simple and there is not much known in the literature on concentration effects[27]. On one side, an effective replacement of solvent molecules by starting material within the Helmholtz-layer is a possible explanation. On the other side, it is possible that in the case of very high concentrations of starting material homogeneous electron-transfer reactions between substrate radical-cations and the starting material outside of the Helmholtzlayer can proceed. In this case, it is not necessary that all molecules have to diffuse to the electrode to be oxidized but some of them could be oxidized in the solution by homogeneous reaction. (electron hopping mechanism) thus avoiding methanol oxidation.

Similar results as described for 5-chloromethyl-2-oxazolidinone (**3**) but with lower yields have been obtained in the anodic oxidation of 5-bromomethyl-2-oxazolidinone (**4**). In the quasi-divided cell 5-bromomethyl-4-methoxy-2-oxazolidinone (**9**) was formed selectively. Whereas in a divided cell 5-bromomethyl-3-methoxymethyl-2-oxazolidinone (**10**) was produced predominantly together with **9** in a ratio of 5 : 1. Due to the more favorable oxidation of **3**, the anodic oxidation of **4** was not further optimized. To

prevent solvent oxidation, for direct oxidations of substrates with high-oxidation potential 2,2,2-trifluoroethanol is proposed by Matsumura et al[28] as a more stable solvent. Thus, we performed the oxidation of 5-chloromethyl-2-oxazolidinone (**3**) in 2,2,2-trifluoroethanol to give 5-chloromethyl-4-(2,2,2-trifluoroethoxy)-2-oxazolidinone (**11**), however only in a yield of 20 %. Besides the low yield and the expensive solvent another limitation using this solvent occurs because the nucleophilic substitution of the trifluoroethoxy group is much more limited as compared with the methoxy substituent.



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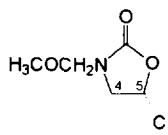

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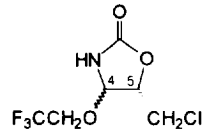

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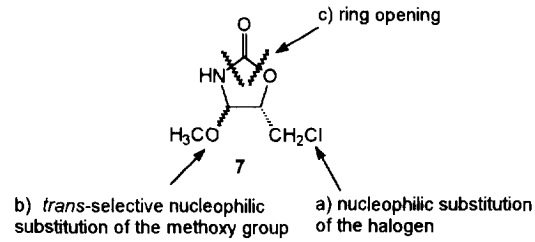
CONCLUSION

The direct electrochemical methoxylation of (*5R*)- or (*5S*)-5-chloromethyl-2-oxazolidinone (**3**) can be performed in 76% yield to give (*4RS,5R*)- or (*4RS,5S*)-**7** as a key building block for further syntheses as shown in Scheme 4. The application of 5-chloromethyl-4-methoxy-2-oxazolidinone (**7**) as chiral amidoalkylation reagent for the synthesis of precursors for potential HIV protease inhibitors is published elsewhere[29].



Scheme 4: Applicability of (*4RS,5S*)-**7** as a key building block for organic syntheses

EXPERIMENTAL

General. Nuclear magnetic resonance (^{1}H NMR) spectra were determined in the reported solvent using a Bruker WH 90 (90 MHz), Bruker AC 200 (200 MHz), Bruker WM 250 (250 MHz) and a Bruker AC 400 (400 MHz) spectrometer. The same instruments were also used for the measurements of ^{13}C spectra (22.6 MHz, 50.3 MHz; 62.9 MHz; 100.6 MHz). Chemical shifts are given in ppm downfield from tetramethylsilane. R_f values were obtained by using thin-layer chromatography (TLC) on silica gel-coated plastic sheets (Merck silica gel F_{254}). All solvents were distilled before using. The relative configurations were determined by comparison of ^{1}H NMR coupling constants with those of known compounds[30] and by measurement of difference NOE spectra.

General procedure for the electrolyses. Starting material, supporting electrolyte and solvent are placed in one of the three following cells: 1. undivided water-cooled beaker type glass cell of 12 mL volume equipped with graphite anode and cathode of equal size (5.2 cm^2); 2. unidivided water-cooled beaker type glass cell of 5 mL volume equipped with a platinum wire cathode and two graphite plate anodes (0.75 cm^2 each) (so-called quasi-divided cell); 3. divided water-cooled beaker type glass cell with 25 mL anode and 6 mL cathode compartments separated by a G4 glass frit and equipped with a platinum wire cathode and a graphite anode (9 cm^2). The electrolyses were performed under stirring at the given temperature and at constant current. The reaction is monitored by tlc. After the elctrolysis is stopped, the solvent is removed in vacuo and the resulting oil purified by column chromatography. Preparation of the electrodes: graphite and carbon black filled polypropylene electrodes were prepared as follows: 1. acetone (ultrasound 5 min); 2. methanol (ultrasound 5 min); 3. methanol p.a. (ultrasound 5 min). Pt-electrodes were cleaned by glowing. All electrolyses were performed in methanol p.a.. The synthesis of the starting materials is published elsewhere[19].

***cis*- and *trans*-5-Hydroxymethyl-4-methoxy-2-oxazolidinone (5) ($C_5H_9NO_4$).** A solution of 5-hydroxymethyl-2-oxazolidinone (**1**) (0.49 g, 5 mmol) and of $NaBF_4$ (0.11 g, 1 mmol) in10 ml of methanol p.a was electrolyzed in the undivided cell type 1 at a current-density of 50 mA/cm^2 at 15°C until the consumption of 5.3 F/mol. After work-up 0.48 g (65%2 (*trans*:*cis* = 8:1) of **5** were obtained. The *cis*:*trans* ratio was determined by GC after silylation of the compound according to *Gupta* et al.[31]. R_f: 0.46 (*trans*), 0.40 (*cis*) (EtOAc/methanol 95:5 v/v). ^{13}C NMR (100.6 MHz, d_6-DMSO): *trans:* δ = 157.9, 85.4, 81.8, 60.7, 53.6 ppm; *cis:* δ =158.0, 84.2, 80.7, 58.6, 55.0 ppm; ^1H-NMR (200 MHz, d_6-DMSO): *trans:* δ = 8.78 (1H, NH, bs), 5.19 (1H, OH, t, ^3J = 5.6 Hz), 4.80 (1H, CHN, dd, ^3J = 1.7, 1.7 Hz), 4.22 (1H, CHO, td, ^3J = 4.5, 1.7 Hz), 3.50 (2H, CH_2O, dd, ^3J = 5.6, 4.5 Hz), 3.21 (3H, CH_3, s) ppm; *cis:* δ = 8.85 (1H, NH, bs), 4.90 (1H, OH, dd, ^3J = 6.1, 6 Hz), 4.88 (1H, CHN, dd, ^3J = 5.4, 0.6 Hz), 4.43 (1H, CHO, ddd, ^2J = 11 Hz, ^3J = 7.6, 6 Hz), 3.68 (1H, CH_2O, ddd, ^2J = 11.7 Hz, ^3J = 7.6, 6 Hz), 3.67 (1H, CH_2O, ddd, ^2J = 11.7 Hz, ^3J = 6, 4.4 Hz), 3.20 (3H, CH_3, s) ppm; MS (FAB; mNBA) *trans: m/z* = 148.1 (M^++H); *cis:* (FAB; glycerin); m/z = 148.1 (M^++H), 240 (M^++H+Matrix), 295 ($2M^+$+H), 332 (M^++H+2 Matrix). [Comment: the compound is very unstable except in solution]

***cis*- and *trans*-5-Methanesulfonyloxymethyl-4-methoxy-2-oxazolidinone (6) ($C_6H_{11}NO_6S$).** A solution of 5-methanesulfonyloxymethyl-2-oxazolidinone (**2**) (0.49 g, 2.5 mmol) and of $NaBF_4$ (0.11 g, 1 mmol) in 10 ml of methanol p.a. was electrolyzed in the undivided cell type 1 at a current-density of 50 mA/cm^2 at 15°C until the consumption of 5.3 F/mol. After work-up 0.30 g (27% (*trans*:*cis* = 4:1) of **6** were obtained. The *cis*:*trans* ratio was determined by NMR). R_f: 0.46 (*trans*), 0.40 (*cis*) (EtOAc/methanol v/v). ^{13}C NMR (22.6 MHz, $CDCl_3$): *trans:* δ =157.9, 85.0, 79.3, 67.5, 54.4, 37.6 ppm; *cis:* δ =156.1, 86.5, 76.2, 66.7, 53.9, 37.6 ppm; ^1H NMR (200 MHz, $CDCl_3$): *trans:* δ = 7.38 (1H, NH, bs), 4.92 (1H, CHN, dd, ^3J = 1.4, 1.4 Hz), 4.60-4.52 (1H, CHO, m), 4.40 (1H, CH_2O, dd, ^2J = 13.9 Hz, ^3J = 2.5 Hz), 4.32 (1H, CH_2O, dd, ^2J = 13.9 Hz, ^3J = 5.3 Hz), 3.32 (3H, OCH_3, s), 3.06 (3H, SO_2CH_3, s) ppm; *cis:* δ = 7.53 (1H, NH, bs), 5.13 (1H, CHN, d, ^3J = 2.8 Hz), 4.60-4.52 (3H, CH_2O, CHO, m), 3.35 (3H, OCH_3, s), 3.08 (3H, SO_2CH_3, s) ppm; MS (FAB; mNBA): *m/z* = 226.1 (M^++H). [Comment: the compound is very unstable except in solution].

(4*RS*,5*S*)-5-Chloromethyl-4-methoxy-2-oxazolidinone (*S*)-(7) ($C_5H_8ClNO_3$). A solution of (*S*)-5-chloromethyl-2-oxazolidinone (**3**) (1.00 g, 7.4 mmol) and sodium benzene sulfonate (0.05 g, 0.3 mmol) in 3.5 ml of methanol p.a. was electrolyzed in the quasi-divided cell type 2 at a current density of 50 mA/cm^2 at -10°C until the consumption of 4.5 F/mol. After work-up 0.92 g (76% (*trans*:*cis* = 5:1) of (*S*)-**7** were obtained. Under the same conditions, 12.00 g (90 mmol) of **3** were electrolyzed in 40 mL of methanol. After work-up 11.00 g (68 mmol) of **7** were obtained. The *cis*:*trans* ratio was determined by NMR. The enantiomeric purity of trans-(*4R,5S*)-**7** was proven in a follow-up reaction using chiral NMR shift reagents after the exchange of the methoxy group by a nucleophile[29]. R_f: 0.29 (*trans*), 0.27 (*cis*) (EtOAc/cyclohexane 1:1 v/v). ^{13}C NMR (50.6 MHz, $CDCl_3$): *trans:* δ =158.4, 86.3, 80.9, 54.5, 42.8 ppm; *cis:* δ =158.6, 84.2, 80.0, 54.3, 39.2 ppm; ^1H-NMR (200 MHz, $CDCl_3$): *trans:* δ = 7.48 (1H, NH, bs), 4.95 (1H, CHN, dd, ^3J = 1.7, 1.7 Hz), 4.58 (1H, CHO, ddd, ^3J = 7.1, 4.2, 1.7 Hz), 3.90 (1H, CH_2Cl, dd, ^2J = 11.3 Hz, ^3J = 4.2 Hz), 3.63 (1H, CH_2Cl, dd, ^2J = 11.3 Hz, ^3J = 7.1 Hz), 3.37 (3H, OCH_3, s) ppm; *cis:* δ = 7.49 (1H, NH, bs), 5.10 (1H, CHN, d, ^3J = 2.3 Hz), 4.55-4.47 (1H, CHO, m), 3.90-3.55 (2H, CH_2Cl, s), 3.35 (3H, OCH_3, s) ppm; MS (FAB; mNBA): *m/z* = 166.1 (M^++H).

5-Chloromethyl-3-methoxymethyl-2-oxazolidinone (8) ($C_6H_{10}ClNO_3$). A solution of 5-chloromethyl-2-oxazolidinone (**3**) (1.00 g, 7.4 mmol) and of $NaBF_4$ (0.11 g, 1 mmol) in 20 ml of methanol p.a. was electrolyzed in the divided cell type 3 at a current density of 40 mA/cm^2 at -10°C until the consumption of 5 F/mol. After work-up 0.67 g (55 %) of **8** were obtained. R_f : 0.55 (EtOAc/cyclohexane 3:2 v/v). ^{13}C NMR (50.6 MHz, $CDCl_3$): δ = 157.1, 75.8, 71.5, 56.0, 45.7, 44.8 ppm; ^1H-NMR (200 MHz, $CDCl_3$): δ = 4.82-4.75

(1H, CHO, bs), 4.62 (2H, OCH_2N, s), 3.72 (1H, NCH_2, dd, ^2J = 9.2 Hz, ^3J = 8.4 Hz), 3.71-3.60 (2H, CH_2Cl, m), 3.55 (1H, NCH_2, dd, ^2J = 9.2 Hz, ^3J = 6.5 Hz), 3.29 (3H, CH_3, s) ppm; MS (EI): *m/z* = 179 (M^+); 148, 130, 114, 76, 68, 42.

5-Chloromethyl-4-(2',2',2'-trifluorethoxy)-2-oxazolidinone (11) ($C_6H_7ClF_3NO_3$). A solution of 5-chloromethyl-2-oxazolidinone (**3**) (0.50 g, 7.4 mmol) and of NEt_4BF_4 (0.23 g, 1 mmol) in 10 ml methanol p.a.was electrolyzed in a beaker type glass cell of 12 mL volume with platinum sheet cathode and platinum cylinder anode at a current-density of 50 mA/cm^2 at -10°C until the consumption of 5 F/mol. After work-up 0.17 g (20 %) of only one isomer of **11** were obtained. The relative configuration could not be determined. R_f : 0.57 (EtOAc/cyclohexane 1:1 v/v). ^{13}C NMR (50.6 MHz, $CDCl_3$): δ = 157.8, 123.4 (1C, q, $^1J_{CF}$ = 278 Hz), 86.6, 81.2, 65.8 (1C, q, $^2J_{CF}$ = 35.2 Hz), 42.2 ppm; ^1H NMR (200 MHz, $CDCl_3$): δ = 7.55 (1H, NH, bs), 5.16 (1H, CHN, s), 4.65 (1H, CHO, m), 4.05-3.58 (4H, CH_2Cl, CH_2CF_3, m) ppm; MS (EI) *m/z* = 234 (M^++H), 198, 128, 113, 83, 62.

***cis-* und *trans*-5-Bromomethyl-4-methoxy-2-oxazolidinone (9) ($C_5H_8BrNO_3$).** A solution of 5-bromomethyl-2-oxazolidinone (**4**) (1.00 g, 5.5 mmol) and of $NaBF_4$ (0.11 g, 0.1 mmol) in 10 ml methanol p.a. was electrolyzed in the quasi-divided cell type 2 at a current density of 50 mA/cm^2 at +15°C until the consumption of 7.5 F/mol. After work-up 0.17 g (15 %) of **9** were obtained. R_f: 0.33 (*trans*), 0.31 (*cis* in traces) (EtOAc/cyclohexane 2:1 v/v). ^{13}C-NMR (50.6 MHz, $CDCl_3$): *trans* δ = 158.0, 87.1, 80.6, 54.5, 29.9 ppm; ^1H-NMR (200 MHz, $CDCl_3$): *trans* δ = 7.54 (1H, NH, bs), 4.88 (1H, CHN, dd, ^3J = 1.6, 1.6 Hz), 4.57 (1H, CHO, ddd, ^3J = 8, 4.8, 1.6 Hz), 3.54 (1H, CH_2Br, dd, ^2J = 11.2 Hz, ^3J = 4.8 Hz), 3.63 (1H, CH_2Br, dd, ^2J = 11.2 Hz, ^3J = 8 Hz) 3.37 (3H, OCH_3, s) ppm; MS (FAB, mNBA) *m/z* = 210.0 (M^++H), 363.1 (M^++Matrix+H).

5-Bromomethyl-3-methoxymethyl-2-oxazolidinone (10) ($C_6H_{10}BrNO_3$). A solution of 5-bromomethyl-2-oxazolidinone (**4**) (1.00 g, 5.5 mmol) and of $NaBF_4$ (0.11 g, 1 mmol) in 20 ml methanol p.a. was electrolyzed in the divided cell type 3 at a current density of 40 mA/cm^2 at +15°C until the consumption of 7 F/mol. After work-up 0.50 g (30 %) of **10** were obtained. R_f: 0.34 (EtOAc/cyclohexane 3:2 v/v). ^{13}C NMR (50.6 MHz, $CDCl_3$): δ = 157.0, 75.8, 71.3, 56.1, 47.0, 33.0 ppm;^1H NMR (200 MHz, $CDCl_3$): δ = 4.82-4.66 (1H, CHO, m), 4.64 (2H, OCH_2N, s), 3.72 (1H, CH_2N, dd, ^2J = 8.8 Hz, ^3J = 8.8 Hz), 3.58-3.44 (3H, CH_2Br, CH_2N, m), 3.28 (3H, OCH_3, s); MS (EI) *m/z* = 222 (3.17 %, M^+), 193, 192, 148, 114, 45, 43 ppm; HRMS calcd for $C_6H_{10}BrNO_3$ (M+): 222.9824; found:222.9824.

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