**Electrochemical Synthesis of Benzoxazoles Mediated
by 2,3-Dichloro-5,6-dicyano-*p*-hydroquinone (DDH) as a Redox Catalyst**

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Abstract:

A novel electrochemical strategy for the efficient synthesis of benzoxazoles has been developed. The chemistry is performed in a beaker-type undivided cell under constant current electrolysis conditions, utilizing 2,3-dichloro-5,6-dicyano-*p*-hydroquinone (DDH) as a redox catalyst.

1. Introduction

Oxidative processes are fundamental to chemistry and biology. Oxidative transformations are frequently performed using stoichiometric amounts of high oxidation-state metal salts, such as chromium (VI), lead (IV) and manganese (VII) compounds [1-2]. Since cost, toxicity, and the generation of hazardous waste may accompany the use of these metal-based oxidants, much effort has been devoted to the development of transition metal catalysis, and especially, metal-free oxidation reactions. In this context, organic iodine-containing reagents, such as PIFA, PIDA, NIS and iodosylbenzene, for example, have proven to be particularly useful [3-6].

The versatile oxidant, 2,3-dichloro-5,6-dicyano-1,4-benzoquinone (DDQ), has frequently been used to achieve a variety of chemical transformations including, for instance, deprotection, dehydrogenation, oxidative cyclization reactions, aromatization, acetal formation and biaryl construction [7-12]. Nevertheless, more than stoichiometric amounts of DDQ are often required, which results in the formation of equivalent amount of 2,3-dichloro-5,6-dicyano-*p*-hydroquinone (DDH) as a waste. This, coupled with the comparatively high cost of DDQ, renders attractive catalytic strategies where DDQ is regenerated by a less expensive stoichiometric amount of co-oxidant. When co-oxidants such as HNO₃ [13] and FeCl₃ [14] are too acidic to be compatible with several functional groups, then a combination of DDQ and MnO₂ is frequently used [15]. In this manner, Lei and co-workers achieved the oxidative C-O coupling of sp³ C-H bonds with carboxylic acids [16]. DDQ can also be regenerated by Mn(OAc)₃, Cosner and coworkers employed 6 equiv of Mn(OAc)₃ to accomplish the selective oxidation of benzylic and allylic alcohol [17]. Despite significant progress, the formation of waste resulting from the simultaneous reduction of the co-oxidant used does not match with the standard of atom-economy and environmental compatibility that is currently required.

Scheme 1. Reversible electrochemical oxidation of DDH

It has been reported that DDQ can be regenerated from the anodic oxidation of DDH (Scheme 1) [18]. Consequently, electrochemical transformations of organic compounds using DDH as a redox catalyst provides an alternative strategy. Utley et al. reported that, in the presence of 25 mol % of DDQ, 2-methyl- and 2-benzyl-naphthalenes are converted into the corresponding carboxyaldehyde or ketone in good yields [19]. Recently, Batista and Crabtree achieved the

electrochemical dehydrogenation of amines to form imines mediated by DDQ [20]. Cycloaddition between in situ generated quinomethanes and terpenes to afford naturally occurring euglobals, using DDQ as a redox mediator, has also reported [21]. Quite recently, Moeller et al. described a general method for conducting oxidation reactions on a microelectrode array in a site-selective fashion using DDQ as a catalytic oxidant [22]. Compared with chemical regeneration of DDQ, electrochemical methods avoid the use of a terminal co-oxidant and consequently eliminate the production of waste resulting from reduction of the co-oxidant, thus simplifying the purification process and reducing the cost of reagents.

Benzoxazoles are frequently found in natural products and pharmaceuticals; they exhibit a variety of biological activities [23-26]. They are often produced through the coupling of a 2-aminophenol with carboxylic acid derivatives, usually under strongly acid conditions and at high temperatures, or from the condensation of 2-aminophenol and aldehydes with subsequent oxidation using an excess of an oxidant [27-32].

Scheme 2. The electrosynthesis of benzoxazoles using DDH as a redox catalyst

We believe that milder, more environmentally benign approaches are needed, and herein describe our efforts to achieve this objective. In keeping with our research focused upon the development and use of indirect electrolysis [33-41], we now report the electrochemically initiated synthesis of benzoxazoles from Schiff bases **1** using DDH as a redox mediator (Scheme 2). The chemistry is performed in a beaker-type undivided cell under constant current electrolysis conditions, and features mild reaction conditions and a simple workup. To the best of our knowledge, it is the first report of the electrochemical cyclization of Schiff bases leading to benzoxazoles and

using DDH as a mediator [42].

2. Experimental

2.1 Instruments and reagents

All melting points were measured with a XT4A Electrothermal melting point apparatus and are uncorrected. IR spectra were recorded as KBr pellets. ^1H NMR spectra were recorded with an AV 400 M Bruker spectrometer (400 MHz ^1H frequency). Chemical shifts are given as δ values (internal standard: TMS). Schiff bases **1a-1i** were synthesized according to known procedures [35, 43]. Other chemicals and solvents were obtained from Beijing Chemicals Co. and used without further purification.

2.2 Cyclic voltammetry

Cyclic voltammograms were measured by a 273A Potentiostat/Galvanostat equipped with electrochemical analysis software, using a conventional three-electrode cell. The working electrode was a glassy carbon disk electrode (ca. $\phi = 3$ mm). The auxiliary and reference electrodes in these studies were Pt wire and Ag/AgNO₃ (0.1 mol/L in CH₃CN) electrode, respectively. Glassy carbon was polished with a polishing cloth before each measurement. NaClO₄ (0.1 mol/L)-CH₃OH was used as the supporting electrolyte and a scan rate of 100 mV/s was used.

2.3 Typical procedure for the synthesis of benzoxazoles **2a-2i** by constant current electrolysis

A beaker-type undivided cell equipped with a Pt anode and an iron plate cathode, which were connected to a DC regulated power supply, was maintained in a water bath at room temperature. To the cell was added Schiff base **1** (0.5 mmol), 2,6-lutidine (1.0 mmol) and DDH (0.1 mmol) in a solution of 10 mL of NaClO₄ supporting electrolyte (0.1 mol/L) in MeOH. The mixture was electrolyzed at a constant current of 20 mA (~ 5 mA/cm²). The electrolysis was terminated when the

starting material, **1**, was consumed as determined by TLC. After electrolysis, the solvent was removed under reduced pressure and the residue was dissolved in water and extraction was carried out using CH₂Cl₂ (3×15 mL); the combined organic layers were dried over MgSO₄, filtered, and concentrated in vacuo. The crude product was purified by column chromatography on silica gel eluted using a mixture of petroleum ether and EtOAc (V/V = 3:1)

2-(*p*-Tolyl)benzoxazole (**2a**) [44]: white solid, yield: 71%; m.p.: 81-82 °C; ¹H NMR (400 MHz, CDCl₃): δ 2.38 (s, 3H), 7.28-7.30 (m, 4H), 7.49-7.51 (m, 1H), 7.68-7.17 (m, 1H), 8.09 (d, *J* = 8.0 Hz, 2H).

2-(4-Methoxyphenyl)benzoxazole [44] (**2b**): white solid, yield: 67%; m.p.: 74-75 °C; ¹H NMR (400 MHz, CDCl₃): δ 3.82 (s, 3H), 6.96 (d, *J* = 8.8 Hz, 2H), 7.25-7.27 (m, 2H), 7.47-7.50 (m, 1H), 7.66-7.68 (m, 1H), 8.13 (d, *J* = 8.8 Hz, 2H).

2-Phenylbenzoxazole (**2c**) [44]: White solid. Yield: 60%; m.p.: 57-58 °C; ¹H NMR (400 MHz, CDCl₃): δ 7.36-7.38 (m, 2H), 7.50-7.56 (m, 3 H), 7.60-7.62 (m, 1H), 7.92-7.80 (m, 1H), 8.28-8.29 (m, 2H).

2-(*o*-Tolyl)benzoxazole (**2d**) [45]: White solid. Yield: 58%; m.p.: 54-55 °C; ¹H NMR (400 MHz, CDCl₃): δ 2.75 (s, 3H), 7.28-7.31 (m, 5H), 7.51-7.54 (m, 1H), 7.73-7.75 (m, 1H), 8.10-8.13 (m, 1H).

2-(4-Bromophenyl)benzoxazole (**2e**) [44]: White solid. Yield: 61%; m.p.: 116-117 °C; ¹H NMR (300 MHz, CDCl₃): δ 7.38–7.40 (m, 2H), 7.59-7.61 (m, 1H), 7.69 (d, *J* = 8.0 Hz, 2H), 7.78-7.80 (m, 1H), 8.14 (d, *J* = 8.0 Hz, 2H).

2-(4-Bromophenyl)-6-methylbenzoxazole (**2f**) [46]: yield: 85%; m.p.: 113-114 °C; ¹H NMR (400 MHz, CDCl₃): δ 2.53 (s, 3H), 7.20 (d, *J* = 8.4 Hz, 1H), 7.40 (s, 1H), 7.64-7.69 (m, 3H), 8.12 (d, *J* = 8.4 Hz, 2H).

2-(4-Bromophenyl)-4-methylbenzoxazole (**2g**) [47]: White solid. Yield: 61%; m.p.: 115-116 °C; ¹H NMR (400 MHz, CDCl₃): δ 2.51 (s, 3H), 7.20 (d, *J* = 7.6 Hz, 1H), 7.47 (d, *J* = 8.4 Hz, 1H), 7.57 (s, 1H), 7.68 (d, *J* = 8.4 Hz, 2H), 8.12 (d, *J* = 8.4 Hz, 2H).

2-(4-Bromophenyl)-5-chlorobenzoxazole (**2h**) [47]: White solid. Yield: 75%; m.p.: 117-118 °C; ¹H NMR (400 MHz, CDCl₃): δ 7.36 (d, *J* = 8.4 Hz, 1H), 7.53 (d, *J* = 7.6 Hz, 1H), 7.69 (d, *J* = 8.8 Hz, 2H), 7.76 (d, *J* = 1.6 Hz, 1H), 8.12 (d, *J* = 8.8 Hz, 2H).

3. Results and discussion

3.1. Electrochemical investigation of DDH-induced benzoxazole synthesis using cyclic voltammetry

Figure 1. Cyclic voltammograms of DDH and Schiff base **1e** in 0.1 mol/L of NaClO₄/CH₃OH, using GC disk working electrode, Pt wire and Ag/AgNO₃ (0.1 mol/L in CH₃CN) as counter and reference electrode at a 100 mV/s scan rate. a: DDH (2 mmol/L). b: Schiff base **1e** (10 mmol/L). c: DDH (2 mmol/L) and Schiff base **1e** (10 mmol/L).

Prior to conducting the preparative scale electrosynthesis of benzoxazoles, we carried out a cyclic voltammetry analysis of DDH in the absence and presence of Schiff base **1e** (Figure 1). As expected, DDH exhibits a well-defined quasi-reversible oxidation wave at +0.43 V vs. Ag/AgNO₃ (0.1 mol/L in CH₃CN) and its corresponding cathodic peak at +0.32 V (curve a) [19]. The former is assigned to be the oxidation of DDH to DDQ and the latter to be reduction of DDQ back to DDH. Curve b in Figure 1 is the CV of Schiff base **1e**, where one irreversible anodic wave at +0.61 V vs Ag/AgNO₃ (0.1 mol/L in CH₃CN) is observed in the range of 0.0 to +1.0 V vs Ag/AgNO₃ (0.1 mol/L in CH₃CN). Curve c is the CV of a mixture of DDH and 5

equiv. of Schiff base **1e**. We observe that the oxidation peak current increased, while the amplitude of reduction wave at +0.35 V vs Ag/AgNO₃ (0.1 mol/L in CH₃CN) decreased. In addition, a second, new cathodic peak at +0.07 V appeared. The results indicates that under these conditions, the electrochemically generated DDQ participates in one or more subsequent reaction(s).

The electrochemical behavior of DDH and **1e** in the presence of an organic base, such as 2,6-lutidine, was also investigated. Cyclic voltammetry analysis showed that the presence of 2,6-lutidine afforded a shift of the oxidation peak potential of DDH to a less positive value. Thus, as shown in Figure 2, the oxidation peak potential of DDH shifted from +0.43 V in the absence of 2,6-lutidine, to +0.26 V vs Ag/AgNO₃ (0.1 mol/L in CH₃CN) (curve a) when 5 equiv. of 2,6-lutidine was added, indicating that DDH is easier to oxidize in the presence of 2,6-lutidine. The observation may stem from a deprotonation of DDH by 2,6-lutidine to generate DDH anion, which is easier to oxidize than DDH itself. Curve b is the CV of Schiff base **1e** in the presence of 5 equiv. of 2,6-lutidine; unlike DDH, no obvious shift of oxidation peak potential was observed. This implies that 2,6-lutidine may not be sufficiently basic to abstract the phenolic proton of **1e**. Finally, we note that the peak current for the oxidation of DDH increased to 98.6 μ A (Figure 2, curve c) from 66.9 μ A (Figure 2, curve a) when 5 equiv. of **1e** was added. Since the oxidation peak potential of **1e** is more positive than that of DDH (+0.72 V vs. +0.26 V) under the identical CV conditions, the increase of the oxidation peak current for DDH can be attributed to a catalytic current, indicating that there is a homogeneous electron transfer between the in situ generated DDQ and **1e**.

Based on the CV analysis described above, we concluded that DDH could use as a redox catalyst to induce the oxidation of Schiff bases, and that it is preferable to carry out the reaction in the presence of a base, such as 2,6-lutidine.

Figure 2. Cyclic voltammograms of DDH and Schiff base **1e** in 0.1 mol/L NaClO₄/CH₃OH in the presence of 2,6-lutidine (10 mmol/L), using GC disk working electrode, Pt wire and Ag/AgNO₃ (0.1 mol/L in CH₃CN) as counter and reference electrode at 100 mV/s scan rate. a: DDH (2 mmol/L) and 2,6-lutidine (10 mmol/L). b: Schiff base **1e** (10 mmol/L) and 2,6-lutidine (10 mmol/L). c: DDH (2 mmol/L), Schiff base **1e** (10 mmol/L) and 2,6-lutidine (10 mmol/L).

3.2. Preparative scale of electrosynthesis of benzoxazoles induced by DDH as a redox catalyst

To demonstrate the feasibility of the electrosynthesis of benzoxazoles induced by DDH as a redox catalyst, (*E*)-2-(4-bromobenzylideneamino)-5- methylphenol **1f** was selected as a model substrate to optimize the electrolytic conditions. Toward this end, a constant current electrolysis of **1f** was carried out in a beaker-type undivided cell using a graphite rod as the anode and a Fe rod as the cathode. As shown in Table 1, when NaClO₄/CH₃OH was used as a supporting electrolyte-solvent combination, the benzoxazole **2f** was obtained in a 48% yield after passing 3.4 F/mol of charge and the disappearance of **1f** as indicated by TLC (entry 1). The use of LiClO₄ as an electrolyte afforded a slightly lower yield (43%)

of **2f** (entry 2). However, an improved yield (55%) of **2f** was obtained when the electrolysis was carried out in CH₃CN solution containing 0.1 mol/L of NaClO₄ (entry 3). Despite the improvement, electrode passivation eventually occurred in acetonitrile. Consequently NaClO₄ in CH₃OH was chosen as the supporting electrolyte and solvent combination to be used when determining the optimal reaction conditions. A platinum anode proved superior to glassy carbon (GC), and delivered a 57% yield of **2f** (entries 2, 4 and 5). Given that the overall transformation is that of a two-electron, two-proton oxidation, and the voltammetry results described above, we reasoned that the presence of a base would prove beneficial; several were screened. As shown in Table 1, use of Na₂CO₃ or NaHCO₃ led to nearly the same yields of **2f** (entry 6), but a dramatically lower yield of **2f** was obtained in the case of K₂CO₃ (entry 7). The moderate to lower yields of **2f** obtained when using an inorganic base can be attributed to its poor solubility in methanol. Consequently, we turned to the soluble organic base, 2,6-lutidine; gratifyingly, an 85 % yield of **2f** was obtained (entry 8). Encouraged by this result, a search for the optimal quantity of 2,6-lutidine was undertaken. It was found that 1 equiv. or 3 equiv. of 2,6-lutidine gave a slightly lower yield of **2f** (entries 9 and 10). Notably, **2f** was obtained in very low yield (7%, entry 11) in the absence of 2,6-lutidine, thereby demonstrating the essential role of a base in the overall transformation, and in accord with the CV results.

Table 1. The conditions optimization for the oxidative cyclization of Schiff base mediated by DDH.^a

entry	supporting electrolyte	anode	DDH (equiv.) ^b	base (equiv.) ^b	J (mA /cm ²)	charge (F/mol)	Yield (%) ^c
2	NaClO ₄	GC	1	Na ₂ CO ₃	10	1.5	55
3	NaClO ₄	GC	1	Na ₂ CO ₃	10	1.5	55
4	NaClO ₄	GC	1	NaHCO ₃	10	1.5	55
5	NaClO ₄	GC	1	NaHCO ₃	10	1.5	55
6	NaClO ₄	GC	1	Na ₂ CO ₃	10	1.5	55
7	NaClO ₄	GC	1	K ₂ CO ₃	10	1.5	5
8	NaClO ₄	GC	1	2,6-lutidine	10	1.5	85
9	NaClO ₄	GC	1	2,6-lutidine	10	1.5	80
10	NaClO ₄	GC	1	2,6-lutidine	10	1.5	80
11	NaClO ₄	GC	1	none	10	1.5	7

1	NaClO ₄ /CH ₃ OH	graphite	0.2	NaHCO ₃ (2.0)	5	3.4	48
2	LiClO ₄ /CH ₃ OH	graphite	0.2	NaHCO ₃ (2.0)	5	3.4	43
3	NaClO ₄ /CH ₃ CN	graphite	0.2	NaHCO ₃ (2.0)	5	3.4	55
4	NaClO ₄ /CH ₃ OH	Pt	0.2	NaHCO ₃ (2.0)	5	3.4	57
5	NaClO ₄ /CH ₃ OH	GC	0.2	NaHCO ₃ (2.0)	5	3.4	52
6	NaClO ₄ /CH ₃ OH	Pt	0.2	Na ₂ CO ₃ (2.0)	5	3.4	53
7	NaClO ₄ /CH ₃ OH	Pt	0.2	K ₂ CO ₃ (2.0)	5	3.4	26
8	NaClO ₄ /CH ₃ OH	Pt	0.2	2,6-lutidine (2.0)	5	3.4	85
9	NaClO ₄ /CH ₃ OH	Pt	0.2	2,6-lutidine (1.0)	5	3.4	70
10	NaClO ₄ /CH ₃ OH	Pt	0.2	2,6-lutidine (3.0)	5	3.4	62
11	NaClO ₄ /CH ₃ OH	Pt	0.2	2,6-lutidine (0.0)	5	3.4	7
12	NaClO ₄ /CH ₃ OH	Pt	0.3	2,6-lutidine (2.0)	5	3.4	81
13	NaClO ₄ / CH ₃ OH	Pt	0.1	2,6-lutidine (2.0)	5	3.4	56
14	NaClO ₄ /CH ₃ OH	Pt	0.0	2,6-lutidine (2.0)	5	3.4	9
15	NaClO ₄	Pt	0.2	2,6-lutidine	10	3.4	53

	/CH ₃ OH			(2.0)			
16	NaClO ₄	Pt	0.2	2,6-lutidine	5	4.0	63
	/CH ₃ OH			(2.0)			

^a Reaction conditions: Schiff base **1f** (0.5 mmol) dissolved in 10 mL of electrolyte, Fe plate cathode; beaker-type undivided cell.

^b The amount of DDH and 2,6-lutidine used is in reference to the Schiff base **1f**.

^c Isolated yield after flash chromatography.

To more clearly identify the role of DDH, we varied the amount used from zero to 0.3 equiv. with respect to **1f**. As illustrated in Table 1, an 81% of **2f** was isolated when 0.3 equiv. of DDH was employed (entry 12), and decreased to 56% when using 0.1 equiv. of DDH (entry 13). Notably, the yield dropped to only 9% in the absence of DDH (entry 14). We therefore conclude that DDH play an essential role in the oxidative cyclization reaction. Finally, the effects of current density and charge were examined. When the current density was raised from 5 to 10 mA/cm², the yield of **2f** decreased from 85% to 53% (entry 15). When the current density was 5 mA/cm² and 4 F/mol of charge was consumed, a 63% yield of **2f** was obtained (entry 16).

Based on results described above, we conclude that the preferred reaction conditions call for using 0.2 equiv. of DDH as the redox catalyst in the presence of 2 equiv. of 2,6-lutidine, Pt as the anode, CH₃OH as the solvent, and NaClO₄ as the conducting salt. The reaction works well when a constant current electrolysis in an undivided cell is conducted at a current density of 5 mA/cm² and passing 3.4 F/mol of charge.

With the optimized conditions in hand (entry 8 of Table 1), we then explored the scope and generality of the reaction. As shown in Table 2, the electrochemical oxidation of each of the Schiff bases afforded the corresponding benzoxazoles in moderate to good yields under the standard reaction conditions. It seems that the electronic character of the substituent appended to the starting benzaldehyde partner

does not influence the reaction in a positive or a negative manner. For example, para substitution of the Schiff base by OCH₃, CH₃ and H affords comparable yields of the corresponding benzoxazoles (entries 1-5). However, steric effects were encountered as is witnessed by the slightly lower yield of benzoxazole **2d** when the methyl group was situated at the *ortho* rather than the *para*-position (compare entries 1 and 4).

In contrast, neither electronic nor steric effects on the *o*-aminophenol partner influence the electrochemical cyclization. As shown in Table 2, the Schiff bases bearing electron-donating (methyl) and electron-withdrawing (Cl) substituents, regardless of their location at either position-5 or 6, all afford good yields of benzoxazoles (entries 6-8). Notice too that the nitro-substituted benzoxazole **2i** did not form, presumably due to the low solubility of the starting Schiff base **1i** in methanol (entry 9).

It is noteworthy that when an equivalent amount of the precursor to Schiff base **1f** viz., 2-amino-5-methylphenol and 4-bromobenzaldehyde was subjected to anodic oxidation under the standard conditions described above, benzoxazole **2f** was obtained in only 19 % yield. The result is not unexpected when one realizes that 2-amino-5-methylphenol easily undergoes anodic oxidation to form corresponding iminocyclohexadienone, which easily decomposes [48].

Table 2. Electrochemical synthesis of benzoxazoles mediated by DDH^a

<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <p>1a-1i</p> </div> <div style="text-align: center;"> <p>20 mol% DDH 2.0 eq 2,6-lutidine 0.1 M NaClO₄/CH₃OH</p> </div> <div style="text-align: center;"> <p>2a-2i</p> </div> </div>			
Entry	Product		Yield ^b
1		2a	71
2		2b	67
3		2c	60

4		2d	58
5		2e	61
6		2f	85
7		2g	78
8		2h	75
9		2i	- ^c

^a Reaction conditions: Pt plate, Fe plate cathode; undivided cell, 0.5 mmol of Schiff base **1**, DDH (0.1 mmol), 2,6-lutidine (1.0 mmol), 10 mL of 0.1 mol/L NaClO₄/CH₃OH, 5mA/cm².

^b Isolated yield.

^c Not detected.

We have previously described an efficient synthesis of 2-substituted benzoxazoles via the electrochemical oxidation of Schiff bases using NaI as a redox mediator in a diphasic electrolytic system [35]. The key step of that approach was proposed to be an intramolecular cyclization of the Schiff base to generate a benzoxazoline [43], which undergoes further oxidation by *in situ* electrochemically generated molecular iodine or hypoiodide to furnish the desired benzoxazoles [35].

We propose the mechanism depicted in Scheme 3 to account for the DDH-mediated electrosynthesis described herein. The sequence begins with an anodic oxidation of DDH to produce DDQ which then engages in a homogeneous electron transfer from the Schiff base **1** to form cation radical, **1**^{•+}. That the transformation can be mediated by DDH is indicated by the fact that only 9% yield of **2f** forms when **1f** is electrolyzed in the absence of DDH, while the yield is 85%, in its presence (note Table 1, entries 8 and 14). The loss of a proton from cation radical **1**^{•+} and a second oxidation leads to a linear vinyl cation **4**, thereby setting the stage for a

geometrically allowable 5-endo,dig cyclization and, after loss of a second proton, the formation of benzoxazole **2**. Although 2,6-lutidine was shown to be insufficiently basic to abstract a proton from Schiff base, its presence undoubtedly facilitates the deprotonation of **1**⁺ and cation **4**, which explains the indispensability of the base.

Scheme 3. A proposed mechanism for the electrochemical synthesis of benzoxazoles mediated by DDH

4. Conclusion

In conclusion, we have developed a novel electrochemical strategy for the efficient synthesis of 2-substituted benzoxazoles. The electrochemical synthesis can be performed under constant current conditions in a simple undivided cell using a catalytic amount of DDH as a redox catalyst. Following optimization of the reaction conditions, 2-substituted benzoxazoles were obtained in good-to-excellent yields and moderate current efficiency. The application of this chemistry to other heterocycles is underway.

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