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Communications

One-Pot Conversion of Nitroarenes into *N*-Arylamides

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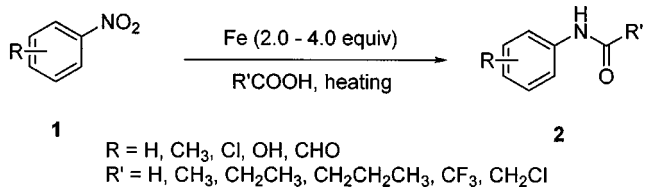
Formanilides are important synthetic intermediates for the synthesis of isocyanides.[1] The conversion of nitroarenes to their corresponding acetanilides in a one-pot reaction is also important in organic chemistry.[2] Besides the formanilides and acetanilides, other types of *N*-arylamide derivatives[3] are useful such as *N*-aryl chloroacetamides for the synthesis of oxindoles *via* the intramolecular Friedel-Crafts reaction.[4]

Direct conversion of nitroarenes into their formanilides can be carried out under catalytic transfer hydrogenation conditions[1a,1b] or with tin in the presence of toluene/formic acid under Dean-Stark trap condition.[1c] Reductive acetylation of nitroarenes to acetanilides can be carried out either by iron/acetic acid,[2a] molybdenum hexacarbonyl/acetic acid,[2b] Zn/Ac_2O in the presence of acidic Al_2O_3[2c] or platinum complex/tin(IV) chloride/CO system.[2d]

The most simple, cheap, convenient and versatile synthesis of various *N*-arylamides might be the sequential reduction of nitro group to amino functionality followed by amide bond formation in a one-pot. In these respects we think that modification of the iron/acetic acid system[2a] might provide the best condition for the synthesis of *N*-arylamides. Fortunately, there was no example on the use of iron/carboxylic acid system, except for acetic acid, to the best of our knowledge. Thus, we examined the so-called reductive *N*-acylation of nitroarenes with various carboxylic acid including formic acid, acetic acid, propionic acid, butyric acid, trifluoroacetic acid and chloroacetic acid. As expected the use of iron in carboxylic acid solvent could be used generally for the reductive *N*-acylation (Scheme 1).



Scheme 1

As shown in Scheme 1 and in Table 1, various kinds of combinations with nitroarenes and carboxylic acids showed similar results. Various functional groups on the nitroarene moiety were tolerable in the reaction conditions (see, entries 2-5). For trifluoroacetic acid (entry 9) and chloroacetic acid (entry 10) we used xylene as a co-solvent in order to decrease the amount of acid. The structure of products could be easily confirmed by their spectroscopic data and melting points of the reported.[1-3]

The procedure is very simple as exemplified for the preparation of *N*-phenylpropionamide (**2g**): A stirred solution of nitrobenzene (246 mg, 2.0 mmol), iron (335 mg, 6.0 mmol) and propionic acid (3 mL) was heated to 120-130 °C during 14 h. After the usual workup process and column chromatographic purification (hexane/ether, 2 : 1) we could obtain **2g** in 78% isolated yield (233 mg) as a white solid. The reaction could be performed on a large scale. As an example the above reaction was performed with 5 g-scale of nitrobenzene (85% yield).

Further studies on the reductive acylation with aliphatic nitro alkanes or on the one-pot synthesis of benzimidazoles or benzoxazoles are underway.

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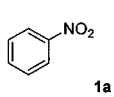
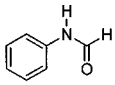
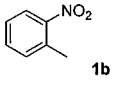
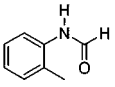
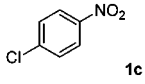
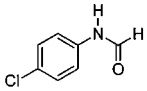
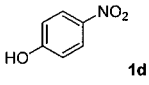
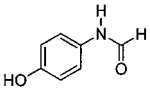
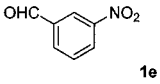
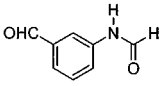
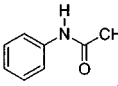
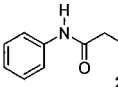
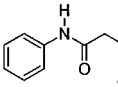
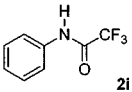
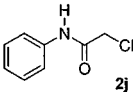
Table 1. Reductive *N*-acylation of nitroarenes

Entry	Nitroarene	Conditions	Product	% Yield[a]
1	 **1a**	Fe (4.0 equiv) HCOOH reflux, 20 h	 **2a**	82 (50-51)[1a]
2	 **1b**	Fe (3.0 equiv) HCOOH reflux, 14 h	 **2b**	76 (63-64)[1a]
3	 **1c**	Fe (3.0 equiv) HCOOH reflux, 14 h	 **2c**	79 (106-107)[1a]
4	 **1d**	Fe (3.0 equiv) HCOOH reflux, 14 h	 **2d**	80 (139-140)[1d]
5	 **1e**	Fe (3.0 equiv) HCOOH reflux, 14 h	 **2e**	78 (98-99)[1c]
6	**1a**	Fe (2.0 equiv) CH_3COOH 100-110 °C, 14 h	 **2f**	81 (115-116)[2a]
7	**1a**	Fe (3.0 equiv) CH_3CH_2COOH 120-130 °C, 14 h	 **2g**	78 (109-110)[3a]
8	**1a**	Fe (3.0 equiv) $CH_3CH_2CH_2COOH$ 120-130 °C, 14 h	 **2h**	66 (97-98)[3b]
9	**1a**	Fe (4.0 equiv) CF_3COOH (10 equiv) xylene, reflux, 20 h	 **2i**	63 (91-92)[3c]
10	**1a**	Fe (4.0 equiv) $ClCH_2COOH$ (10 equiv) xylene, reflux, 20 h	 **2j**	71 (140-141)[3d,3e]

[a]Mp was written in parenthesis.

References and Notes

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