Reduction of Haloanilines and Benzylnitriles with Raney Alloys in an Aqueous Na2CO3 Solution

Kakinami, Takaaki
Department of Chemical and Biological Engineering, Ube Technical College

Yamanaka, Kazuhiro
Department of Chemical and Biological Engineering, Ube Technical College

Yamanishi, Masae
Department of Chemical and Biological Engineering, Ube Technical College

Tsukinoki, Takehito
Institute of Advanced Material Study, Kyushu University

他

https://doi.org/10.15017/17344

出版情報：九州大学大学院総合理工学報告. 16 (3), pp.307-310, 1994-12-01. 九州大学大学院総合理工学研究科
バージョン：
権利関係：

九州大学大学院総合理工学研究科報告
第16巻 第3号 307-310頁 平成6年12月

Engineering Sciences Reports, Kyushu University
(KYUSHU DAIGAKU SOGORIKOGAKU KENKYUKA HOKOKU)
Vol. 16, No. 3, pp. 307 - 310, DEC. 1994

Reduction of Haloanilines and Benzylnitriles with Raney Alloys in an Aqueous Na_2CO_3 Solution

Takaaki KAKINAMI*, Kazuhiro YAMANAKA*, Masae YAMANISHI*
Takehito TSUKINOKI**, Shuntaro MATAKA*** and Masashi TASHIRO***

(Recieved August 31, 1994)

Various haloanilines and benzylnitriles were treated in a 1.25N Na_2CO_3 solution with Raney Cu-Al or Ni-Al alloy. In the case of haloanilines, dehalogenated anilines were obtained in good yield. On the other hand, the reduction of benzylnitriles afforded the corresponding 2-arylethylamines.

Introduction

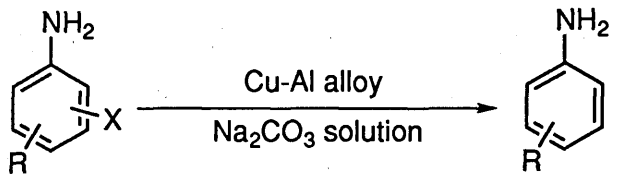
It has been previously reported that deuteriated phenoxyacetic acid[1], thiophene-2-carboxylic acids[2], benzoic acids[3], and phenols[4] were prepared in good yield and in high isotopic purities from the corresponding halogenated derivatives by the reductive dehalogenation with Raney alloys in 10% Na_2CO_3-D_2O solution. Recently we found that benzaldehyde was reduced to benzyl-α-d_1-alcohol in high isotopic purity by using this method.[5] By using Raney Cu-Al alloy-aq. 10% NaOD system, we have already prepared the deuteriated anilines[6] and 2-phenylethylamine[7] in good yield and in high isotopic purities from the corresponding halogenated anilines and benzylnitrile, however NaOD-D_2O solution is expensive.

As a preliminary work to prepare deuteriated anilines and 2-arylethylamines using Na_2CO_3 as a base, the reduction of haloanilines and benzylnitriles with Raney alloys in an aqueous Na_2CO_3 solution was investigated.

Results and Discussion

The results of the reduction of haloanilines (**1**) with Raney Cu-Al alloy in a 1.25N Na_2CO_3 solution are shown in **Table 1**. Chloro atom (s) as well as bromo atom (s) was reduced even a weak base such as a 1.25N Na_2CO_3 solution was used. It was found that the both methods A and B afforded the corresponding dehalogenated aniline derivatives (**2**) in considerable yields. The above results suggest that this reducing system using a 1.25N Na_2CO_3 solution as a base is practical for preparation of the corresponding deuteriated anilines. Using Raney Ni-Al alloy instead of Raney Cu-Al alloy in the reducing system mentioned above, 2-arylethylamine derivatives were selectively obtained from the corresponding benzylnitriles (**Table 2, Scheme 2**). In the case of the reduction of chlorobenzylnitriles, Raney Co-Al and Cu-Al alloy gave a complex mixture of undefined

*Department of Chemical and Biological Engineering, Ube Technical College, Tokiwadai, Ube, 755, Japan
**Institute of Advanced Material Study, Kyushu University
***Department of Molecular Science and Technology



1 **2**

a: 2,4,6-Br_3- i: 2,4,6-Br_3-3,5-Cl_2- a: R=H

b: 2-Cl-4,6-Br_2- j: 2,4-Br_2-6-Me- b: R=2-Me

c: 2,6-Br_2-4-Cl- k: 2,4,6-Br_3-3-Me- c: R=3-Me

d: 2-Br-4,6-Cl_2- l: 2,6-Br_2-4-Me- d: R=4-Me

e: 2,6-Cl_2-4-Br- m: 2,4-Br_2-5,6-Me_2- e: R=5,6-Me_2

f: 2,4,6-Br_3-3-Cl- n: 2,6-Br_2-3,4-Me_2- f: R=3,4-Me_2

g: 2,4-Br_2-5,6-Cl_2- o: 2,4,6-Br_3-3-OMe- g: R=3-OMe

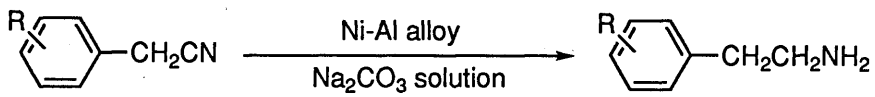
h: 2,6-Br_2-3,4-Cl_2-

Scheme 1

Table 1 Reduction of haloanilines (**1**) with Raney Cu-Al alloy in a 1.25N Na_2CO_3 solution at 60℃ for 1h affording anilines (**2**).

Run	**1**[a]	Cu-Al (g)	Method[b]	Yield of **2** (%)
1	**1a**	7.5	A	**2a** (60)
2	**1b**	14.9	A	**2a** (88)
3	**1c**	14.9	A	**2a** (61)
4	**1d**	18.3	B	**2a** (55)
5	**1e**	23.0	B	**2a** (69)
6	**1f**	19.8	A	**2a** (48)
7	**1g**	21.4	B	**2a** (53)
8	**1h**	30.5	B	**2a** (98)
9	**1i**	34.4	A	**2a** (64)
10	**1j**	11.6	B	**2b** (80)
11	**1k**	13.2	A	**2c** (93)
12	**1l**	8.3	A	**2d** (73)
13	**1m**	18.2	B	**2e** (80)
14	**1n**	11.6	A	**2f** (65)
15	**1g**	12.4	A	**2g** (91)

a) Haloanilinea: 6.5mmol, 1.25N Na_2CO_3 solution: 50ml. b) Method A: Raney Cu-Al alloy was gradually added to a mixture of haloanilines, a 1.25N Na_2CO_3 solution and 20 ml of THF. Method B: A 1.25N Na_2CO_3 solution was added to a mixture of haloanilines, Raney Cu-Al alloy, and 20 ml of THF.



3

a: R=H
b: R= 2-Cl
c: R=3-Cl
d: R=4-Cl
e: R=3,4-Cl_2
f: R=2,6-Cl_2-
g: R=2-Me
h: R=3-Me
i: R=4Me
j: R=3,4-MeO_2
k: R=4-Phenyl
l: α–phenylbenzylnitrile
m: α–naphtylacetonitrile

4

a: R=H
b: R=2-Me
c: R=3-Me
d: R=4-Me
e: R=3,4-Me_2
f: R=4-phenyl
g: β–phenylethylamine
h: β–(α–naphtyl)ethylamine

Scheme 2

Table 2 Rediction of benzylnitriles (**3**) with Raney Ni-Al alloy in a 1.25N Na_2CO_3 solution at 60℃ for 1h affording 2-arylethylamines (**4**).

Run	3[a)]	Ni-Al (g)	Yield of **4** (%)
1	**3a**	2.4	**4a** (76)
2	**3b**	5.3	**4a** (72)
3	**3c**	9.0	**4a** (64)
4	**3d**	6.2	**4a** (69)
5	**3e**	9.0	**4a** (33)
6	**3f**	7.7	**4a** (58)
7	**3g**	3.8	**4b** (76)
8	**3h**	2.4	**4c** (76)
9	**3i**	5.3	**4d** (64)
10	**3j**	9.0	**4e** (84)
11	**3k**	3.8	**4f** (83)
12	**3l**	3.8	**4g** (91)
13	**3m**	3.8	**4h** (61)

a) Benzlynitriles: 6.5 mmol, 1.25N Na_2CO_3 solution: 50ml.

products.

It was earlier found that hydrogen-deuterium exchange did not occur when halogenated phenoxyacetic acid, thiophene-2-carboxylic acids, and benzoic acids were treated with Raney Ni-Al alloy in a Na_2CO_3 solution.[1)-3)] Thus, it is expected that when this method is applied for deuteration of benzylniyriles, deuteriated 2-arylethylamines will be obtained in high isotopic purities. The deuteration of the halogenated anilines and benzylnitriles using

Raney alloys-Na_2CO_3-D_2O as the reducing system are now in progress.

On the other hand, the reduction of benzonitriles with Raney Ni-Al alloy in a 1.25N Na_2CO_3 solution gave a complex mixture of products including dibenzylamines. Dibenzylamine was also obtained together with the expected benzylamine and benzamide in the reduction of benzonitrile with Raney Ni-Al alloy in a 5% NaOH solution as earlier reported.[8]

Experimental

Reduction of haloanilines with Raney Cu-Al alloy

Two typical procedures are given below.

Typical procedure A: To a stirred mixture of 2,4,6-tribromoaniline (2.14 g, 6.5 mmol), a 1.25N Na_2CO_3 solution (50 ml) and THF (20 ml), powder of Raney Cu-Al alloy (7.5 g) was gradually added for 1h at 60 ℃. After the reaction mixture was stirred for 1h at 60 ℃, insoluble materials were filtered off. The filtrate was acidified with conc. HCl and extracted with CH_2Cl_2 (40 ml×4). The extrate was dried over $MgSO_4$, and evaporated *in vacuo* to give aniline (0.36 g, 60%).

Typical procedure B: To a stirred mixture of 2,4-dibromo-o-toluidine (1.72 g, 6.5 mmol), Raney Cu-Al alloy (11.6 g), THF (10 ml) and water (10 ml), a solution of a 1.25N Na_2CO_3 solution (50 ml) was slowly added dropwise. After the reaction mixture was stirred for 1h at 60 ℃, insoluble materials were filtered off. The filtrate was acidified with conc. HCl and extracted with CH_2Cl_2 (40 ml × 4). The extrate was dried over $MgSO_4$, and evaporated *in vacuo* to give o-toluidine (0.56 g, 80%).

Reduction of nitriles with Raney Ni-Al alloy

This reduction was carried out in the same manner (typical procedure A) as described above.

References

1) M. Tashiro, A. Iwasaki, and G. Fukata, *J. Org. Chem.*, **43**, 196 (1978).
2) M. Tashiro, S. Mataka, K. Nakayama, H. Tsuzuki, and T. Yonemitsu, *J. Chem. Res.* (*S*), 1988, 136.
3) M. Tashiro, H. Tsuzuki, J. Matsumoto, S. Mataka, K. Nakayama, Y. Tsuruta, and T. Yonemitsu, *J. Chem. Res.* (*s*), 1989, 372.
4) T. Kakinami, Y. Iida, S. Kajigaeshi, H. Eguchi and M. Tashiro, *Rep. Res. Inst. Ind. Sci.* (Kyushu Daigaku Kinoh Bussitu Kagaku Kenkyusho Hohkoku), in press.
5) T. Tsukinoki, K. Ishimoto, H. Tsuzuki, S. Mataka, and M. Tashiro, *J. Labelled Comp. Radiopharm.*, **33**, 987 (1993).
6) M. Tashiro, H. Tsuzuki, T. Tsukinoki, S. Mataka, K. Nakayama, and T. Yonemitsu, *J. Labelled. Comp. Radiopharm.*, **28**, 703 (1990).
7) T. Tsukinoki, H. Tsuzuki, K. Ishimoto, K. Nakayama, T. Kakinami, S. Mataka, and M. Tashiro, *J. Labelled Comp. Radiopharm.*, *J. Labelled Comp. Radiopharm.*, **34**, 839 (1994).
8) M. Tashiro, T. Tsukinoki, K. Nakayama, and S. Mataka, *Rep. Res. Inst. Ind. Sci.* (Kyushu Daigaku Seisan Kagaku Kenkyusho Houkoku), **82**, 117 (1987).