JOM 23207

4-Phenylbenzylidene benzylamine: a new and convenient reagent for the titration of solutions of lithium alkyls and metal amides

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(Received July 10, 1992)

Abstract

4-Phenylbenzylidene benzylamine is shown to be an excellent reagent for the determination of solutions of lithium alkyls and metal amides. The azaallyl anion produced is deep blue in tetrahydrofuran, and fades to pale yellow via red when titrated with 2-butanol in xylene. The method can also be used for estimation of the dryness of the solvent. The crystalline indicator is easily prepared, stored and handled.

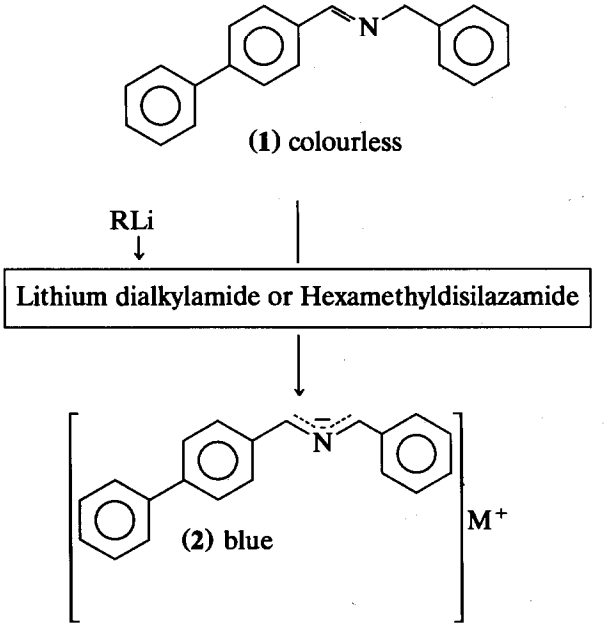
1. Introduction

We have already described a method for the determination of alkyllithium solutions [1] and lithium diisopropylamide solutions [2], using *N*-benzylidene benzylamine azaallyllithium anion as indicator (titrated with 2-butanol solution) [1]. Other methods have recently been described [3] and a procedure specially devoted to amide bases solutions has also been reported [4].

We describe here an improvement of our previously published method [1], using a new imine indicator. We chose 4-phenylbenzylidene benzylamine (**1**) as the indicator for accurate determination of alkyllithium and amide bases solutions.

Compared to the reagents for our earlier method [1], compound **1** has the advantages of being crystalline, easy to handle, and more stable. The derived azaallylanion (**2**) presents a very deep blue colour, turning red a few drops before the end point (pale yellow), which is very easy to observe (method A).

In addition to its versatility (see Table 1), the present method can give information about the quality of the THF or THF/$^{i}Pr_2NH$ medium used for alkyllithium-promoted reactions. Indeed, three consecutive titrations can be carried out in the same vessel, by addition of a new aliquot of the unknown basic solution after the previous titration (2-butanol/xylene). If the medium is not perfectly dry, the first estimation is obviously lower than the two others. This thus gives an "apparent" molarity which can be considered as the effective basicity in the THF medium. The second and third values indicate the absolute molarity of the basic solution. The difference between the apparent and real concentrations is a measure of the protic impurities



Scheme 1.

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0022-328X/93/$6.00

TABLE 1. Determination of lithium alkyl and metal amide solutions

Unknown solution [a]	Nominal value	Determination		Other determination [b]
		method A [c]	method B [d]	
LiMe/Et_2O	1.60	1.65	1.66	1.65
		1.66	1.68	
		1.66		
Li^{t}Bu/pentane	1.70	1.62	1.60	1.65
		1.60	1.64	
		1.64		
LiPh/cyclohexane/Et_2O	2.00	1.96	1.94	1.98
		1.98	1.98	
		1.99		
Li^{n}Bu/hexane	2.50	2.40	2.40	2.40
		2.41	2.40	
		2.42		
NaHMDS/THF [f]	1.00		1.05	
			1.06	
KHMDS/toluene [f]	0.50		0.53	
			0.54	
Li^{t}Bu/pentane	1.70	1.42 [e]	1.68	1.66
		1.64	1.70	
		1.68		
Li^{n}Bu/hexane	2.50	2.02 [e]	2.50	2.52
		2.52	2.52	
		2.52		

[a] Commercial solutions from Aldrich. [b] According to ref. 1. [c] The three titrations are carried out in the same vessel (see text). [d] Independent titrations. [e] Titrations carried out in THF not dried prior to use. [f] HMDS = hexamethyldisilazamide.

contained in the THF/amine medium. Such information ("apparent" and real molarity, dryness of the solvent) are of prime interest for further reactions using the alkyllithium solution in the same solvent.

We are also suggesting an alternative estimation in which the alkyllithium solution is added from a syringe to a colourless solution of imine 1 in a known aliquot of the acidic solution (2-butanol in xylene). The pale yellow-to-blue end point is also very sharp and easy to observe (method B). This second method is faster since it does not require THF and diisopropylamine. Moreover, it allows the titration of sodium and potassium hexamethyldisilazamide solutions. In conclusion, we have discovered a useful, simple and versatile indicator for determining alkyllithiums and metal amides.

2. Experimental details

NMR spectra were recorded on a Bruker AC200 spectrometer (^{1}H NMR: 200 mHz; ^{13}C NMR: 50 mHz). IR spectra were recorded on a Perkin–Elmer 16PC FTIR apparatus. The mass spectrum was obtained on a JEOL JMS AX500 apparatus. Melting points and enthalpies of fusion were determined on a DSC 101 Setaram differential scanning calorimeter.

2.1. 4-Phenylbenzylidene benzylamine (1)

To a solution of 4-phenylbenzaldehyde (1.3 g, 7.14 mmol) in dichloromethane (20 ml) was added dropwise benzylamine (0.82 g, 7.6 mmol). The reaction mixture was kept at room temperature over 4 Å molecular sieves for 48 h. Filtration and removal of solvent gave 1.9 g of a yellow powder (crude yield: 97%). Recrystallization (5 ml Et_2O + 15 ml of hot pentane, then room temperature for 16 h) gave 1.1 g of white needles (56%, m.p. 62°C). A second crop (yellow plates) was obtained by removal of the solvent from the mother liquor and recrystallization of the residue in 5 ml of hexane (25%, m.p. 53.1°C). The two crops are polymorphic forms of compound 1. Both materials can be used for titrations.

^{1}H NMR ($CDCl_3$): 8.42 (s, 1H); 7.85, 7.64 (4H, AA'BB', J = 8.3 Hz); 7.62 to 7.20 (m, 10H); 4.65 (s, 2H) ppm. ^{13}C NMR ($CDCl_3$): 161.9 (CH); 143.7 (C); 140.7 (C); 140 (C); 135.4 (C); 129.1 (CH); 129 (CH); 128.8 (CH); 128.3 (CH); 128 (CH); 127.6 (CH); 127.4 (CH); 127.3 (CH); 65.4 (CH_2). IR (KBr; cm^{-1}): form I (needles): 1646 (C=N), form II (plates): 1650 (C=N). MS (EI): 272, 271 (M^+), 270, 194 ($M - C_6H_5$), 193, 180 ($M - CH_2Ph$), 179, 165, 152, 117, 91.

Anal. Found: C, 88.34; H, 6.39; N, 5.06. Calc.: C, 88.52; H, 6.32; N, 5.16%.

X-Ray powder diffraction: *d* spacing (Å) (relative intensity), form I (needles): 11.8 (m); 7.8 (m); 6.55 (vw); 5.53 (w); 5.25 (m); 4.70 (vs); 4.52 (m); 4.35 (m); 4.15 (vs), form II (plates): 35 (w); 17.2 (w); 11.2 (w); 8.4 (m); 5.62 (w); 4.70 (vs); 4.52 (m); 4.46 (m); 4.33 (m); 4.25 (m); 4.10 (m); 3.84 (vs).

2.2. *Titration method A*

A 0.5 ml aliquot of the solution to be analyzed is added at room temperature under argon to a solution of freshly distilled diisopropylamine (0.28 g, an excess) and of *ca.* 15–20 mg of imine **1** in 2 ml of dried THF. The deep blue colouration of the azaallyllithium anion appears immediately after the addition. The solution is then titrated with a 1 M solution of 2-butanol in xylene. The colour turns from blue to red a few drops before the end point, which is reached when the colour changes to pale yellow. In a second determination, a new 0.5 ml aliquot of the solution to be analyzed is added to the previous mixture, and the resulting blue solution is again titrated.

2.3. *Titration method B*

The unknown basic solution is added from a syringe at room temperature under argon to a colourless solution of *ca.* 20 mg of imine **1** in 2 ml of 1 M 2-butanol in xylene. A sharp yellow-to-blue end point indicates the equivalence. This procedure has to be used for sodium and potassium hexamethyldisilazamide solutions, but is not convenient for the lithium derivative.

Acknowledgment

Dr. G. Coquerel is gratefully acknowledged for the crystallographic study and the DSC measurements, as well as for helpful discussions about polymorphism.

References

1 L. Duhamel and J. C. Plaquevent, *J. Org. Chem., 44* (1979) 3404; *N*-benzylidene benzylamine is commercially available from Aldrich.
2 (a) H. O. House, G. S. Nomura, D. Vanderveer and J. E. Wissinger, *J. Org. Chem., 51* (1986) 2408; (b) H. O. House, G. S. Nomura and D. Vanderveer, *J. Org. Chem., 51* (1986) 2416.
3 See references cited in ref. 1 and: (a) M. R. Winkle, J. M. Lansinger and R. C. Ronald, *J. Chem. Soc., Chem. Commun.*, (1980) 87; (b) M. F. Lipton, C. M. Sorensen, A. C. Sadler and R. H. Shapiro, *J. Organomet. Chem., 186* (1980) 155; (c) D. E. Bergbreiter and E. Pendergrass, *J. Org. Chem., 46* (1981) 219; (d) E. Juaristi, A. Martinez-Richa, A. Garcia-Rivera and J. S. Cruz-Sanchez, *J. Org. Chem., 48* (1983) 2603; (e) J. Suffert, *J. Org. Chem., 54* (1989) 509; (f) Y. Aso, H. Yamashita, T. Otsubo and F. Ogura, *J. Org. Chem., 54* (1989) 5627; (g) H. Kiljunen and T. Ase, *J. Org. Chem., 56* (1991) 6950.
4 R. E. Ireland and R. S. Meissner, *J. Org. Chem., 56* (1991) 4566.