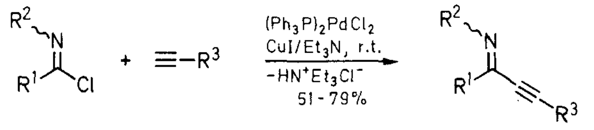
A Convenient Palladium-Catalyzed Synthesis of Alkynyl Substituted Schiff's Bases by Coupling of Imidoyl Chlorides with 1-Alkynes

Shou-Yuan Lin,*[a] Huai-Yu Sheng,[b] Yao-Zeng Huang[b]

[a] Department of Chemistry, East China Normal University, Shanghai, People's Republic of China
[b] Shanghai Institute of Organic Chemistry, Academia Sinica, Shanghai, People's Republic of China

Alkyne substituted Schiff's bases 3 for example *N*-(1-phenyl-2-hexynylidene)aniline (3e), were conveniently synthesized from imidoyl chlorides 1 and 1-alkynes 2 in the presence of a palladium catalyst.

In order to study whether or not alkyne substituted Schiff's bases would undergo an analogous rearrangement to alkynyl ketones which give furans in the presence of palladium catalyst,[1] we first needed to prepare the starting compounds. Literature survey showed that Grignard reagents were used for the preparation of Schiff's bases[2] but the latter, once formed, were found to react further with the Grignard reagent.[3] Alternatively, *N*-(1-phenyl-2-alkynylidene)arylamines could be prepared via palladium-catalyzed coupling of imidoyl chlorides with phenylethynyltributyltin at higher temperature (70–130 °C).[4] On the other hand, preparation of Schiff's bases from imidoyl chlorides with lithium *tert*-butoxy(methyl)cuprates has been reported,[5] but subsequent workup (pH 7,5) gave imines and their hydroly-



1 **2** **3a-h**

1	R^1	R^2	**2**	R^3
a	Ph	Bu	**a**	Bu
b	Ph	Et	**b**	Pr
c	Ph	Ph	**c**	Ph
d	2,4-$Cl_2C_6H_3$	Et	**d**	$CH_2C_6H_{11}$-*c*

3	R^1	R^2	R^3	**3**	R^1	R^2	R^3
a	Ph	Bu	Bu	**f**	Ph	Bu	Ph
b	Ph	Et	Bu	**g**	Ph	Et	Ph
c	Ph	Ph	Bu	**h**	2,4-$Cl_2C_6H_3$	Et	Ph
d	2,4-$Cl_2C_6H_3$	Et	Bu	**j**	Ph	Ph	Ph
e	Ph	Ph	Pr	**j**	Ph	Ph	$CH_2C_6H_{11}$-*c*

Table. 1-Alkylnyl Azomethines 3 Prepared

Product	Reaction Time (h)	Yield (%)	mp (°C) or bp (°C)/Torr	Molecular Formula or Lit. bp (°C)/Torr	IR (neat or KBr) (cm^{-1})		^1H-NMR ($CDCl_3$/TMS) δ, *J* (Hz)	MS *m*/*z* (rel. intensity)
					$\nu_{C\equiv C}$	$\nu_{C=N}$		
3a	4	60	120–122/0.3	$C_{17}H_{23}N$ (241.4)	2200	1590	0.6–1.9 (m, 14H), 2.45 (t, 2H, *J* = 6), 3.65 (t, 2H, *J* = 6.5), 7.1–7.5 (m, 3H), 7.7–8.1 (m, 2H)	242 ($M^+ + 1$, 57)
3b	5	51	104–105/0.4	$C_{15}H_{19}N$ (213.3)	2200	1590	0.6–1.7 (m, 10H), 2.45 (t, 2H, *J* = 6), 3.65 (q, 2H, *J* = 7), 7.1–7.5 (m, 3H), 7.75–8.1 (m, 2H)	214 ($M^+ + 1$, 100), 213 (M^+, 20)
3c	4	60	141–143/0.3	149/0.01[10]	2210, 2180	1580	0.7 (t, 3H, *J* = 6), 0.9–1.5 (m, 4H), 2.2 (t, 2H, *J* = 6), 6.7–7.5 (m, 8H), 7.95–8.25 (m, 2H)	262 ($M^+ + 1$, 83.5), 261 (M^+, 100)
3d	5	53	140–142/0.3	$C_{15}H_{17}Cl_2N$ (282.2)	2250	1595	0.6–1.7 (m, 10H), 2.3 (t, 2H, *J* = 6), 3.65 (q, 2H, *J* = 7), 7.0–7.45 (m, 3H)	283 ($M^+ + 1$, 21), 282 (M^+, 100)
3e	4	54	134–136/0.3	$C_{18}H_{17}N$ (247.3)	2200	1590	0.75 (t, 3H, *J* = 6), 1.35 (m, 2H), 2.15 (t, 2H, *J* = 6), 6.75–7.45 (m, 8H), 7.9–8.2 (m, 2H)	247 (M^+, 38)
3f	5	59	144–146/0.3	$C_{19}H_{19}N$ (261.4)	2200	1580	0.8 (t, 3H, *J* = 6), 1.1–1.9 (m, 4H), 3.7 (t, 2H, *J* = 6.5), 6.8–7.5 (m, 8H), 7.75–8.2 (m, 2H)	262 ($M^+ + 1$, 20.6), 261 (M^+, 25.2)
3g	2	57	126–129/0.3	$C_{17}H_{13}N$ (233.3)	2200	1590	1.25 (t, 3H, *J* = 7), 3.8 (q, 2H, *J* = 7), 7.1–7.65 (m, 8H), 7.8–8.15 (m, 2H)	234 ($M^+ + 1$, 100), 233 (M^+, 60.4)
3h	5	61	61–62	$C_{17}H_{17}Cl_2N$ (302.2)	2220	1580	1.3 (t, 3H, *J* = 7), 3.8 (q, 2H, *J* = 7), 7.0–7.55 (m, 8H)	301 (M^+, 24.8)
3i	4	66	61–61.5	52–54[7]	2200	1580	6.6–7.45 (m, 13H), 7.9–8.2 (m, 2H)	282 ($M^+ + 1$, 38), 281 (M^+, 98)
3j	4	79	oil	$C_{22}H_{23}N$ (301.4)	2220, 2190	1590	0.5–1.7 (m, 11H), 2.0 (d, 2H, *J* = 5), 6.65–7.4 (m, 8H), 7.8–8.15 (m, 2H)	302 ($M^+ + 1$, 50), 301 (M^+, 83.2)

[a] All reactions were carried out at r.t. under N_2.
[b] Isolated yield, based on **2**.
[c] Satisfactory microanalyses obtained: C ±0.34, H ±0.22, N +0.35.

tic products, i.e. the corresponding ketones. In the only one reported[6] example *N*-phenylbenzimidoyl chloride was reacted with ethynyltrimethylsilane in the presence of palladium acetate/triphenylphosphine as catalyst at 80 °C to give *N*-[1-phenyl-3-(trimethylsilyl)-2-propynylidene]aniline.

We report here a convenient route for the synthesis of alkynyl substituted Schiff's bases **3** by coupling of imidoyl chlorides **1** with 1-alkynes **2** in the presence of bis(triphenylphosphine)palladium(II) chloride and copper(I) iodide at room temperature in moderate to good yield. Our method avoids the use of stoichiometric amounts of organometallic reagents (such as in the cases of magnesium, tin, copper and silver reagents[7]), which could be troublesome in large scale preparation. Moreover, the reaction can be conducted at lower temperature compared to other reported methods.[4]
The experimental conditions and the yields of the products are listed in the Table. We found that copper(I) iodide plays an important role in this reaction, since in its absence the yields of final products were rather poor.

In summary, we have shown that, acetylenic hydrogen can be readily substituted by reaction with organic halides of relatively low reactivity in diethylamine[8] or triethylamine[9] in the presence of copper(I) iodide/bis(triphenylphosphine)palladium(II) chloride as catalyst to afford useful organic intermediates.

^{1}H-NMR spectra were recorded on a Varian EM-360A spectrometer. Mass spectra were obtained using a Finnigan GC-MS 4021 spectrometer.

N-(1-Phenyl-2-hexynylidene)aniline (3e); Typical Procedure:
To a mixture of $PdCl_2(PPh_3)_2$ (35 mg, 0.5 mmol) and CuI(20 mg) in Et_3N (10 mL) are added 1-pentyne (**2b**; 200 mg, 3 mmol) and *N*-phenylbenzimidoyl chloride (**1c**; 861 mg, 4 mmol). The mixture is stirred at r.t. for 4 h under N_2 and the solvent is removed under reduced pressure. Water (20 mL) is added and the mixture is extracted with Et_2O (60 mL). The organic layer is dried ($MgSO_4$) and evaporated *in vacuo*. The residue is purified by column chromatography on silica gel [eluent: EtOAc/petroleum ether (bp 60–90 °C), 1:9] to give **3e**; yield. 401 mg (54 %).

Received: 6 July 1990; revised: 2 October 1990

(1) Sheng, H.-Y.; Lin, S.-Y.; Huang, Y.Z. *Tetrahedron Lett.* **1986**, *27*, 4893.
Sheng, H.-Y.; Lin, S.-Y.; Huang, Y.Z. *Synthesis*, **1987**, 1022.
(2) Marquis, M.R. *C.R. Acad. Sci.* **1906**, *142*, 111.
Busch, M.; Fleischmann, M. *Ber. Dtsch. Chem. Ges.* **1910**, *43*, 2553.
Busch, M.; Falco, F. *Ibid.* **1910**, *43*, 2557.
(3) Ng, K.; Alper, H. *J. Organomet. Chem.* **1980**, *202*, 1.
Ng, K.; Alper, H. *J. Org. Chem.* **1981**, *46*, 1039.
(4) Kobayashi, T.-A.; Sakakura, T.; Tanaka, M. *Tetrahedron Lett.* **1985**, *26*, 3463.
(5) Karady, S.; Amato, J.S.; Weinstock, L.M.; Sletzinger, M. *Tetrahedron Lett.* **1978**, 403.
(6) Austin, W.B.; Bilow, N.; Kelleghan, W.J.; Lau, K.S.Y. *J. Org. Chem.* **1981**, *46*, 2280.
(7) Ukhin, L.Yu.; Orlova, Zh.I.; Tokarskaya, O.A. *Dokl. Akad. Nauk SSSR* **1986**, *288*, 897; *C.A.* **1987**, *106*, 102150.
(8) Sonogashira, K.; Tohda, Y.; Hagihara, N. *Tetrahedron Lett.* **1975**, 4467.
(9) Tohda, Y.; Sonogashira, K.; Hagihara, N. *Synthesis* **1977**, 777.
(10) Bourgain, M.; Normant, J.-F. *Bull. Soc. Chim. Fr.* **1973**, 2137.