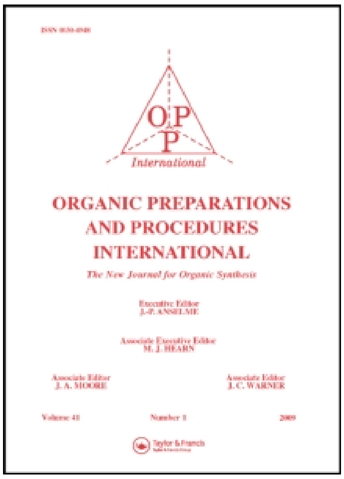

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LOW VALENT TITANIUM INDUCED ONE-POT SYNTHESIS OF IMIDAZOLIDINES

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LOW VALENT TITANIUM INDUCED ONE-POT SYNTHESIS OF IMIDAZOLIDINES

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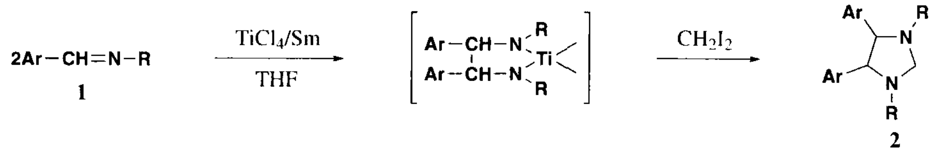
Since its introduction by McMurry[1] and two other groups[2] in the 1970's, low-valent titanium has been extensively investigated as a versatile reagent in organic synthesis, especially with its exceptional ability to promote reductive coupling of many functional groups.[3-5] Alexakis and co-workers reported the synthesis of the symmetrical vicinal dl-diamines from the corresponding imines using low-valent titanium species generated using $TiCl_4$ and Hg-Mg reagent system.[6] Periasamy and his group described the use of $TiCl_4$/Mg powder in the reaction of certain imines with 1,2-dibromoethane leads to imidazolidines in 54-74% yields.[7] More recently Chen and co-workers reported the reaction of imines and trimethyl orthoformate induced by $TiCl_4$/Zn powder system to give imidazolidines in moderate yields.[8] In connection with our interest in investigating new reduction coupling reactions induced by low-valent titanium, now we describe the cross-coupling reaction of Schiff bases with methylene diiodide to give imidazolidine derivatives.

When a mixture of imine and methylene iodide was treated with low-valent titanium in THF for given time (*Table 1*), the cross-coupling product imidazolidines were formed in moderate to good yields (*Scheme 1*).



Scheme 1

Table 1. Synthesis of Imidazolidines from Imine and Methylene Iodide

Cmpd	Ar	R	Time (*h*)	Yields[a,b] (%)	mp. (*lit.*[9]) (°C)
2a	C_6H_5	$(CH_2)_6$	12	73	118-120
2b	p-$CH_3C_6H_4$	$(CH_2)_6$	12	75	146-150
2c	p-$CH_3OC_6H_4$	$(CH_2)_6$	12	75	152-154
2d	C_6H_5	C_3H_7	14	65	80-81
2e	p-ClC_6H_4	C_3H_7	14	60	100-101(101-103)
2f	C_6H_5	C_7H_{15}	12	75	124-126
2g	2,4-$Cl_2C_6H_3$	C_2H_5	10	65	95-97 (97-99)
2h	2,6-$Cl_2C_6H_3$	C_3H_7	10	60	91-93 (92-95)

a) All products were identified by spectral data of ^1H NMR and IR. b) Isolated as a mixture of *cis*- and *trans*-isomer.

TABLE 2 Analytical Date for Compounds **2**

Compd	IR	MS	^{1}H NMR	Elemental Analysis (found)		
	(cm^{-1})	m/z(%)	(δ)	C	H	N
2a	3080, 2958, 1160	188 (100.00) 388 (6.82)	7.38-6.93 (m, 10 H), 3.82-3.60 (s, 2 H), 3.24-0.86 (m, 24 H)	83.46 (83.44)	9.34 (9.32)	7.21 (7.18)
2b	3085, 2950, 1165	202 (100.00) 416 (6.34)	7.40-6.92 (m, 8 H), 3.80-3.50 (s, 2 H), 2.40-2.35 (s, 6 H), 3.24-0.86 (m, 24 H)	83.60 (83.57)	9.68 (9.65)	6.72 (6.71)
2c	3070, 2955, 1150	218 (100.00) 448 (5.33)	7.41-6.80 (m, 8 H), 3.80-3.73 (s, 2 H), 3.70 (s, 6 H), 3.25-0.90 (m, 24 H)	77.64 (77.65)	8.99 (8.95)	6.24 (6.26)
2d	3070, 2940, 1150	148 (100.00) 308 (2.99)	7.41-6.95 (m, 10 H), 3.82-3.56 (d, 2 H), 3.28-0.89 (m, 16 H)	81.78 (81.74)	9.15 (9.20)	9.08 (9.04)
2f	3080, 2940, 1160	204 (100.00) 420 (4.71)	7.42-6.92 (m, 10 H), 3.82-3.56 (s, 2 H), 3.30-0.89 (m, 32 H)	82.80 (82.78)	10.54 (10.50)	6.66 (6.63)

In conclusion, we believe that the present work may provide a useful method for the synthesis of imidazolidine derivatives from simple starting materials. It is anticipated that further investigations on the utilization of low-valent titanium should be fruitful.

EXPERIMENTAL SECTION

Tetrahydrofuran was distilled from sodium-benzophenone immediately prior to use. Infrared spectra were recorded on a Perkin-Elmer 683 spectrometer as KBr pellets with absorption in cm^{-1}. ^{1}H-NMR spectra were determined on a Bruker AC 80 MHz instrument, with CCl$_4$ used as the solvent . Chemical shifts were expressed in ppm downfield from internal standard tetramethylsilane. Mass spectra were recorded on HP5989B mass spectrometer. Elemental analyses were carried out on an EA 1110 instrument. The starting material imines were prepared by a published method.[10]

General Procedure for the Synthesis of Imidazolidines. -A dry 50 mL flask was charged with Sm powder (2 mmol), TiCl$_4$ (0.22 mL, 2 mmol) and THF (15 mL). The mixture was refluxed for 2 hours under nitrogen, then cooled to room temperature. When black slurry was formed, a solution of imine (2 mmol) and of methylene diiodide (1.1 mmol) in THF (5 mL) was added to the reaction mixture, and stirred for about 10 hours at room temperature. The black reaction mixture was quenched with saturated K$_2$CO$_3$ solution (2N, 5 mL) and extracted with CHCl$_3$ (3 x 10mL). The combined organic extract was washed with brine (10 mL), then dried over with anhydrous MgSO$_4$ and concentrated. The residue was chromatographed on a silica gel column and the imidazolidine derivative was isolated using 5% ethyl acetate in hexane as eluent.

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REDUCTIVE COUPLING OF CARBONYL COMPOUNDS TO PINACOLS WITH SAMARIUM/TMSCl SYSTEM

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A number of systems have been developed for the preparation of pinacols from the reductive coupling of carbonyl compounds, *e. g.* magnesium,[1] aqueous titanium trichloride in basic media,[2] low