The macrocyclic tetraamido-*N* ligand class used here is unique. In spite of the voluminous literature of macrocyclic polyamines and Schiff bases, only one example, prior to our work, of a complex of a macrocyclic tetraamido-*N* ligand (a cyclic tetrapeptide) has been reported (as part of a classic study of copper(III) chemistry by Margerum et al.[11,12]). That copper(III) complex proved susceptible to degradation via chemistry involving hydrogen substituents β to the amido-*N* donor.[11b] The ligand class shown in Figure 1 possesses no β-hydrogens and can be systematically varied at the "a" through "j" positions. We are currently studying the reactions and physical properties of these unprecedented oxo complexes and the broader chemistry of a family of complexes of the tetraamide ligands.

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Supplementary Material Available: A listing of atomic coordinates, anisotropic thermal parameters for non-hydrogen atoms, bond lengths involving non-hydrogen atoms, bond angles involving non-hydrogen atoms, and complete details of the analysis of $[Et_4N][Mn(O)(\eta^4\text{-}1)]$ (29 pages); a listing of structure factor amplitudes for $[Et_4N][Mn(O)(\eta^4\text{-}1)]$ (12 pages). Ordering information is given on any current masthead page.

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Organotin Triflate Promoted Carbonyl Activation. Does Acetalization Deactivate or Activate Carbonyl Groups?

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Addition of nucleophiles to carbonyl groups constitutes one of the most fundamental reactions in organic synthesis. Mukaiyama found acetals to serve as carbonyl equivalents in the Lewis acid promoted reaction with enol silyl ethers.[1] In this respect, acetalization works not to protect (or deactivate) but to activate carbonyls. It would be of great synthetic value if we could control at will reactivities of carbonyls through acetalization. As an example along this line, Noyori et al. reported that trimethylsilyl triflate (TMSOTf) was milder than the usual Lewis acids to preferentially promote the reaction of acetals with enol silyl ethers in competing reactions with a carbonyl compound.[2] Reetz,[3] and Yamamoto[4] later, disclosed that an aldehyde underwent selective protection through titanium or aluminum amide mediated aminoacetalization, leaving a coexisting ketone intact, and subsequently the ketone was alkylated. Luche also utilized the same concept for the selective $NaBH_4$ reduction of ketones in the presence of an aldehyde which was preferentially deactivated as a hydrated form with the aid of $CeCl_3$.[5] Now we have found that dibutyltin bis(triflate) (**1**) catalyzes the reaction with a variety of silyl nucleophiles in a quite unusual manner leading to synthetically promising differentiation of carbonyl groups. Namely, in contrast to smooth reaction with aldehydes, no reaction takes place with ketones. However, through acetalization, ketones are activated and are capable of undergoing addition of silyl nucleophiles while aldehydes are deactivated, giving rise to inert acetals. This finding has allowed ketones to react in preference to an aldehyde in a one-pot manner.

Scheme I

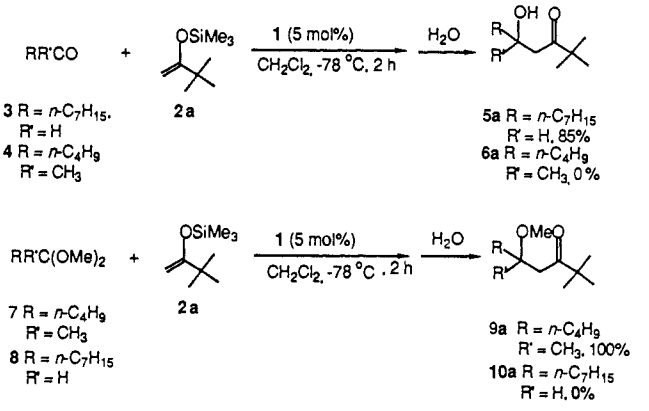
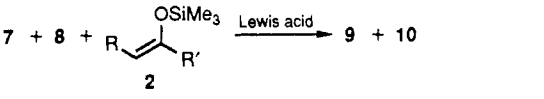


Table I. Crossover Aldol Reaction between Acetals of Ketone and Aldehyde[a]



2			yield,[b] %		
R	R'	Lewis acid[c]	9	10	9:10
H	C_6H_5	**1** (0.05)	78	1	99:1
CH_3	C_2H_5	**1** (0.05)	80	1	99:1
H	t-C_4H_9	**1** (0.05)	80	0	100:0
		$TiCl_4$ (1.0)	28	8	78:22
		$SnCl_4$ (1.0)	72	28	72:28
		$AlCl_3$ (1.0)	30	21	58:42
		TMSOTf (0.1)	50	9	85:15
		$TrClO_4$ (0.1)	49	6	89:11
		$SnCl_2$ (0.1)-TMSCl (0.2)	37	13	74:26
		CF_3SO_3H (0.1)	81	19	81:19

[a] Reaction conditions: **7**:**8**:**2** = 1:1:1, dichloromethane, -78 °C, 2 h. [b] Determined on the basis of GLC analysis. [c] The amount employed is given in parentheses.

Exposure of octanal (**3**) to the enol silyl ether **2a** in the presence of **1**[6,7] at -78 °C afforded the aldol product **5a** in 80% yield after column chromatographic isolation while no reaction occurred with 2-hexanone (**4**) (Scheme I),[8] in accord with the known relative reactivities of aldehydes and ketones. Note, however, that TMSOTf failed to activate either type of carbonyl under similar conditions.[2] In this sense, **1** is more active than the silicon analogue.

Next, acetals were subjected to the same reaction (Scheme I). The ketone acetal **7** reacted smoothly while the aldehyde acetal **8** reacted quite sluggishly. Other enol ethers gave similar results (Table I). Of more importance is the fact that no such distinct discrimination was observed with other Lewis acids such as $TiCl_4$,[9] $SnCl_4$, $AlCl_3$, TMSOTf,[10] trityl perchlorate ($TrClO_4$),[11]

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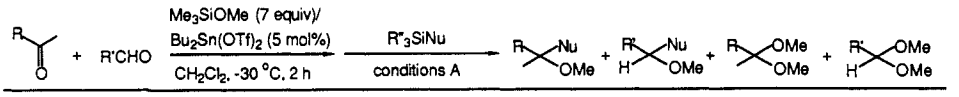
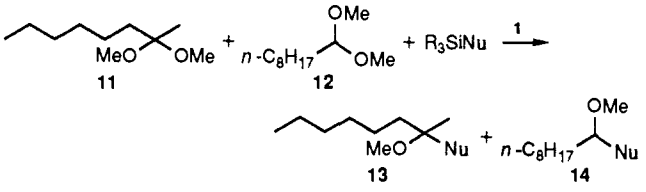
Scheme II



R	R'	R"$_3$SiNu	conditions A				
n-C_4H_9	n-C_7H_{15}	OSiMe$_3$ (1.7 equiv)	-50 °C, 8 h	95% (94:6)	6%	3%	76%
n-C_8H_{13}	n-C_8H_{17}	OSiMe$_3$ (2.0 equiv), OMe	0 °C, 10 h	89% (92:8)	8%	11%	71%
		Me$_3$SiCN (1.1 equiv)	-78 °C, 2 h	90% (99:1)	1%	0	72%
		Et$_3$SiH (2.0 equiv)	-10 °C, 9 h	89% (92:8)	8%	5%	75%

Table II. Crossover Reaction of Acetals of Ketone and Aldehyde with Various Silyl Nucleophiles[a]



	yield,[b] %			
R_3SiNu	**13**	**14**	**(13/14)**	**13:14**
Et_3SiH[c]	87	5		95:5
Me_3SiCN	74	4	(73)	95:5
Cl_3Si [d]	47	1	(44)	98:2
OSiMe$_3$ [e], OMe	63	4	(60)	94:6

[a] Reaction conditions: **11**:**12**:R_3SiNu:**1** = 1:1:1:0.05, dichloromethane, −78 °C, 2 h. [b] Determined on the basis of GLC analysis. Isolated yields of the mixtures of **13** and **14** after column chromatography are given in parentheses. [c] Five hours. [d] Temperature −10 °C. [e] Three hours.

$SnCl_2$–TMSCl,[12] and CF_3SO_3H.[13,14] Apparently, **1** can perceive a delicate difference between two kinds of acetals. In this sense, **1** is more selective than the other Lewis acids. Consequently, the reactivities of the ketone and the aldehyde were completely reversed through acetalization.

The synthetic potential of this procedure is demonstrated by the successful employment of other silyl nucleophiles (Table II).

Finally, a novel preferential one-pot transformation of ketones in the presence of aldehydes was achieved. An aldehyde–ketone mixture (each 1 equiv) was converted into the corresponding acetal mixture by treating with trimethylmethoxysilane (7 equiv) using **1** as a catalyst at −30 °C for 2 h in dichloromethane.[15] Then, a silyl nucleophile was added to this solution under the conditions shown in Scheme II. GLC analyses exhibited the selective formation of the ketone adducts. This methodology not only provides a conceptually new mode of carbonyl differentiation but also meets versatile synthetic demands due to recent extensive developments of silicon-based nucleophile reagents.

The success of the present reaction is ascribed to the unique catalytic activity of **1**, which serves for acetalization of carbonyls and the subsequent preferential addition of the silyl nucleophiles to the ketone acetals in a one-pot manner. Probably, the mild reactivity of **1** is primarily responsible for the soft activation of ketone acetals, leaving cationically less reactive aldehyde acetals unchanged.[16] The mildness of **1** as compared with TMSOTf is rather surprising in view of the generally accepted criterion for the Lewis acidity of organotin and -silicon compounds. The difference is attributable to the reduced oxygenophilicity of tin in comparison with silicon.[17]

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Sequential Radical Cyclization, Alkoxy Radical Fragmentation, and Recyclization Processes: A Novel Method for the Synthesis of Fused Cycloheptanones and Cyclooctenones from Cyclohexanones

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The formation of C–C bonds via radical reactions has witnessed a renaissance recently, particularly in intramolcular cyclization processes leading to the preparation of complex natural products.[1] While C–C multiple bonds have generally served as the radical acceptor in these cyclization approaches, a significant limitation of this methodology is that the cyclization process often results in a decrease in the functional complexity of the substrate. Recently the addition of carbon radicals to carbonyl groups was reported, which should allow for the preparation of cycloalkanols.[2] Another feature of the radical cyclization involving carbonyl groups is that the resulting alkoxy radicals may be useful for

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