

AN OLEFIN POLYANION EQUIVALENT: A NEW OLEFIN SYNTHESIS FROM TRIFLONES

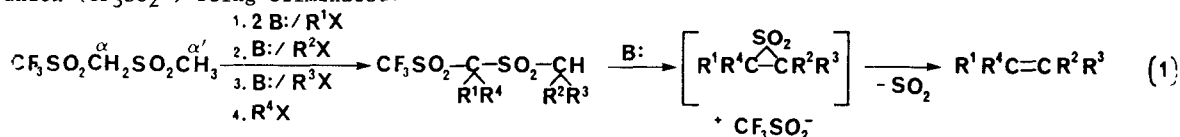
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Summary: α -Triflyl-dimethylsulfone ($\text{CF}_3\text{SO}_2\text{CH}_2\text{SO}_2\text{CH}_3$) is a reagent which allows successive polyalkylation of the two carbons with regiocontrol. The polyalkylated triflyl-sulfone then undergoes a Ramberg-Bäcklund reaction with loss of triflate anion and extrusion of SO_2 to form an olefin. In synthetic terms the net structural change is equivalent to regiospecific alkylation of an olefin polyanion, $\text{C}=\text{C}^-$.

In our studies of the logic of synthesis design¹ it became clear that efficiency depended, inter alia, on a high proportion of skeletal construction reactions and is further improved by carrying out several successive constructions in one operation. This is made possible by designing a "nuclear synthon" capable of such successive constructions. We have here married the versatility of the triflyl group² with the Ramberg-Bäcklund olefin synthesis³ to produce such a reagent in α -triflyl-dimethylsulfone, to be used as summarized in eq. 1. The triflyl group serves both to stabilize carbanions for alkylation and ultimately as a leaving group, triflate anion (CF_3SO_2^-) being eliminated.²



The α -carbanion is much more stable and less reactive than the α' -, so as to differentiate cleanly the successive alkylations (or similar constructions with higher electrophiles). The overall transformation allows for up to five constructions on the primary reagent, the order of addition of the R-groups determining their regiochemical positions on the ultimate double bond. This nuclear synthon is therefore a poly-nucleophile, in effect the synthetic equivalent of an olefin polyanion, $\text{C}=\text{C}^-$.

The reagent itself (mp 117°) is simply made by acylating dimethylsulfone anion with triflyl fluoride or anhydride. Its α -monoanion is very stable ($\text{pK} \sim 4$) and its dianion ($\text{BuLi/THF}/-78^\circ$) is apparently the α, α' -dianion, analogous to $(\text{CF}_3\text{SO}_2)_2\text{C}^-$,⁴ since it is rapidly and exclusively monoalkylated to the α -monoalkyl derivative. Two more successive additions of base and alkylating agents at -78° proceed as indicated in eq. 1 with full regiocontrol to yield the α -monoanion of an α, α', α' -trialkylated species. This much more stable residual α -anion is easily separated into aqueous phase for isolation and its presence protects the triflyl group from premature elimination. The fourth alkylation requires elevated temperature or prolonged time at room temperature as well as more active alkylating agents (benzyl bromide or primary triflates).

Whenever the α -position is dialkylated, elimination may proceed as in eq. 1; these were commonly found to occur, after α' -anion formation at -78° (BuLi/THF), on warming between -50° and -20° . Examples are summarized in Table I. While the regiospecificity of alkylation is

quite clean, the stereospecificity is not. The final slow alkylation at α commonly affords two diastereomers; in the traditional Ramberg-Bäcklund elimination of halide each diastereomer leads independently⁵ to a single isomer of the final olefin with high stereospecificity ($\sim 20:1$). In making 1,1-disubstituted olefins, cyclic olefins, or tri- and tetrasubstituted acyclic olefins with identical substituents at one carbon, this lack of stereocontrol presents no problem.

We present this preliminary report at this time owing to analogous work on acyl-sulfones which has recently appeared.⁶ Full details with yield optimization will follow; it is clear that to achieve the full planned efficiency of successive constructions without isolation, the alkylation conditions must be finely optimized, and this is currently under study. Reactions with other electrophiles have also been examined and appear to be as generally applicable; so the range of this method for rapid synthesis of functionalized olefins promises to be quite broad.

References

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Table I

SUBSTRATE	Alkylating agent	PRODUCT					mp (yield)	Yield: elimination to Olefin, $R^1R^4C=CR^2R^3$
		ID	R ⁴	R ¹	R ²	R ³		
Reagent (A)	CH ₃ I	B	-	Me	-	-	70° (93)	-
A	n-C ₅ H ₁₁ I	C	-	Pe	-	-	47° (65)	-
A	C ₆ H ₅ CH ₂ Br	D	-	Bz	-	-	111° (94)	-
A	2CH ₃ I	E	Me	Me	-	-	oil (85)	52% (b)
A	2CH ₃ I (a)	F	-	Me	Me	-	oil (95)	-
A	2C ₆ H ₅ CH ₂ Br (a)	G	-	Bz	Bz	-	74° (92)	-
A	Br(CH ₂) ₃ Br (a)	H	-	(CH ₂) ₃	-	-	95° (87)	-
B	C ₆ H ₅ CH ₂ Br	I	-	Me	Bz	-	oil (87)	-
C	Br(CH ₂) ₃ Br	J	Pe	(CH ₂) ₃	-	-	oil (66)	65%
I	CH ₃ OTf	K	Me	Me	Bz	-	oil (83)	75% (b)
I	C ₂ H ₅ OTf	L	Et	Me	Bz	-	oil (73)	83%
F	C ₂ H ₅ OTf	M	Et	Me	Me	-	oil (95)	-
G	C ₂ H ₅ OTf	N	Et	Bz	Bz	-	oil (70)	60% (b)
F	C ₆ H ₅ CH ₂ Br	O	-	Me	Me	Bz	87° (90)	-
O	C ₆ H ₅ CH ₂ Br	P	Bz	Me	Me	Bz	oil (64)	52% (b) (c)
H	C ₆ H ₅ CH ₂ Br	Q	-	(CH ₂) ₃	Bz	-	157° (98)	-
A	CH ₃ I; n-C ₅ H ₁₁ I	R	-	Me	Pe	-	oil (70)	-
B	Br(CH ₂) ₃ Br	S	Me	(CH ₂) ₃	-	-	90° (71)	-
B	Br(CH ₂) ₄ Br	T	Me	(CH ₂) ₄	-	-	97° (67)	-
R	Br(CH ₂) ₃ Br	U	Me	(CH ₂) ₃	Pe	-	oil (93) (d)	60%
R	Br(CH ₂) ₄ Br	V	Me	(CH ₂) ₄	Pe	-	oil (87) (d)	70%

(a) 3 moles base (BuLi) affords α, α' -dialkylation directly; (b) recovered starting material subtracted; (c) also the unsaturated sulfone from elimination of TfH at α -benzyl; (d) mixture of diastereomers.

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