*Journal of Fluorine Chemistry, 38* (1988) 175–181



Received: April 21, 1987; accepted: September 29, 1987

# A ONE-POT SYNTHESIS OF PENTAFLUORO- AND POLYFLUORO-PHENYL ALKYL KETONES

YANCHANG SHEN* and WEIMING QIU

Shanghai Institute of Organic Chemistry, Academia Sinica

345 Lingling Lu, Shanghai (China)

## SUMMARY

A one-pot synthesis of pentafluoro- and polyfluorophenyl alkyl ketones via ozonolysis of fluorinated phosphoranes is described. In view of the fact that one-pot reaction without isolation of intermediates and the total yield in 3 steps reaches 51-60%, the present method provides a convenient synthesis of the title compounds.

## INTRODUCTION

To the best of our knowledge, only a few reports have appeared in the literature concerning the synthesis of pentafluorophenyl alkyl ketones. Reaction of pentafluorobenzoic ester with Grignard reagent only gave pentafluorophenyl alkyl ketones in 2-31% yields contaminated with a large amount of by-products [1]. Pentafluorophenylcopper reacts with acid chlorides to give pentafluorophenyl alkyl ketones in moderate to good yields [2] but polyfluorophenyl alkyl ketones have not been reported pre-

0022-1139/88/$3.50 

viously. We now wish to report a one-pot synthesis of pentafluoro- and polyfluoro-phenyl alkyl ketones via ozonolysis of fluorinated phosphoranes.

## RESULTS AND DISCUSSION

It has been reported that oxidation of alkylidene- or benzylidene-triphenylphosphoranes by oxygen gave olefins and carbonyl compounds [3], but the relatively stable benzoylbenzylidenetriphenylphosphorane ozonolysed to give benzil [4]. We found that in alkyl pentafluoro- or polyfluoro-benzylidenetriphenylphosphoranes ozone could be used to give fluoroketones. The title compounds have been prepared by the following reaction sequence: Alkylidenetriphenylphosphoranes were generated from alkyltriphenyl phosphonium bromides and phenyllithium in ether and submitted to reaction with hexafluorobenzene [5] or chloropentafluorobenzene to give pentafluorophenyl- or chlorotetrafluorophenyl-triphenylphosphoranes, which, in the reaction medium was ozonolysed to give the products **4**.

$$\underset{\mathbf{1}}{Ph_3\overset{+}{P}CH_2RBr^-} \xrightarrow{PhLi} \underset{\mathbf{2}}{Ph_3P{=}CHR}$$

$$2\ \underset{\mathbf{2}}{Ph_3P{=}CHR} + C_6F_5X \longrightarrow \underset{\mathbf{3}}{Ph_3P{=}C(R)C_6F_4X\text{-}p} + Ph_3\overset{+}{P}CH_2RX^-$$

$$\mathbf{3} \xrightarrow{O_3} \underset{\mathbf{4}}{p\text{-}XC_6F_4COR}$$

a R=n-$C_3H_7$; X=F  e R=n-$C_5H_{11}$; X=F

b R=n-$C_3H_7$; X=Cl  f R=n-$C_5H_{11}$; X=Cl

c R=n-$C_4H_9$; X=F  g R=n-$C_7H_{15}$; X=F

d R=n-$C_4H_9$; X=Cl  h R=n-$C_7H_{15}$; X=Cl

The results are summarized in Table 1.

TABLE I

Pentafluorophenyl- and polyfluorophenyl alkyl ketones prepared.

| Compound | Reaction condition | | b.p. | Yield |
|---|---|---|---|---|
| | Temp.(°C) | Time(h) | (°C/mmHg) | (%) |
| **4a** | 5 | 1.5 | 75/5 | 54 |
| **4b** | 5 | 1.5 | 95/5 | 60 |
| **4c** | 5 | 3 | 85/5 | 46 |
| **4d** | 5 | 3 | 104/5 | 55 |
| **4e** | 25 | 3 | 94/5 | 55 |
| **4f** | 25 | 3 | 116/6 | 53 |
| **4g** | 25 | 6 | 135/10 | 54 |
| **4h** | 25 | 6 | 150/10 | 51 |

It has been shown in Table 1 that as the number of carbon atoms of the alkyl group in fluorinated phosphoranes 3 increased the reaction temperature and time had to be higher

and longer to afford similar yields. In the case of chloropentafluorobenzene, the alkylidenetriphenylphosphoranes nucleophilically attacked the para position regiospecifically to give compounds **3**, after ozonolysis p-chlorotetrafluorophenyl alkyl ketones resulted exclusively.

In view of the fact that products **4** are obtained by a one-pot reaction without isolation of intermediates and the total yields in 3-steps are 51-60%, the present method provides a convenient synthesis of the title compounds.

## EXPERIMENTAL

All boiling points were uncorrected. Infrared spectra of liquid products were determined as films on a Shimadzu IR-440 Spectrometer. NMR spectra (chemical shifts in ppm from TMS for $^{1}H$ NMR and from external TFA for $^{19}F$ NMR, positive for upfield shifts) were obtained on a EM-360 Spectrometer at 60 MHz. Mass spectra were recorded on a Finnigan GC-MC 4021 Mass Spectrometer.

### General procedure for preparation of ketones **4**

Methyllithium (5 mmol, 15 ml of absolute ether) was added dropwise with stirring over 0.75 h to a suspension of alkyl triphenylphosphonium bromide (5 mmol) in absolute ether(50 ml) at 25°C under nitrogen. The mixture is cooled to 5°C and hexafluorobenzene or chloropentafluorobenzene (2.5 mmol)was added.After addition, the mixture is allowed

to stir for 1.5 h, to stand for 4 hours, the clear liquid was transferred to another flask under nitrogen and ozone was bubbled into the solution at -60°C until the disappearance of characteristic ylidic colour.Then the mixture was allowed to come slowly to 25°C, to stand overnight and the filtrate was collected. Evaporation of the solvent to give residue which was purified by column chromatography on silica gel eluting with petroleum ether (30-60°C)/ethyl acetate (50:1) to give product **4**.

4a: 54% yield; b.p. 75°C/5 mmHg(Lit. data b.p. 83°C/9 mmHg [1]; IR (film): 1710(s) $cm^{-1}$; $^{1}H$ NMR ($CDCl_3$): δ 0.98 (t,3H,J=7Hz);1.37-1.92(m,2H);2.74(t,2H,J=7Hz); $^{19}F$ NMR ($CDCl_3$): δ 64.2-65.4(m,2F); 73.7-74.7(m,1F); 83.0-84.5 (m,2F) ppm; MS m/e: 238($M^+$), 195($M^+-C_3H_7$).

4b: 60% yield; b.p. 95°C/5 mmHg; IR (film): 1720(s) $cm^{-1}$; $^{1}H$ NMR ($CDCl_3$): δ 0.99(t,3H,J=7Hz), 1.40-1.96(m,2H); 2.75(t,2H,J=7Hz); $^{19}F$ NMR ($CDCl_3$): δ 60.0-61.0(m,2F); 62.2-63.2 (m,2F) ppm; MS m/e: 254($M^+$), 211($M^+-C_3H_7$). Analysis: Calcd for $C_{10}H_7ClF_4O$: C,47.17,H,2.77, Found: C,47.40, H,2.41.

4c: 46% yield; b.p. 85°C/5 mmHg(Lit. data b.p. 94°C/9 mmHg [1]; IR(film): 1720(s) $cm^{-1}$;$^{1}H$ NMR ($CDCl_3$): δ 0.75-1.94 (m,7H); 2.78(t,2H,J=7Hz); $^{19}F$ NMR ($CDCl_3$): δ 62.1-63.2 m,2F); 71.2-72.2(m,1F); 80.2-81.6(m,2F) ppm; MS m/e: 252($M^+$), 195($M^+-C_4H_9$).

4d: 55% yield; b.p. 104°C/5 mmHg; IR (film): 1710(s) $cm^{-1}$; $^{1}H$ NMR ($CDCl_3$): δ 0.72-1.98(m,7H); 2.78(t,2H,J=7Hz); $^{19}F$ NMR($CDCl_3$): δ 59.4-60.5(m,2F);61.7-62.9(m,2F) ppm; MS m/e: 268($M^+$), 211($M^+-C_4H_9$). Analysis: Calcd for $C_{11}H_9ClF_4O$: C,49.18, H,3.38, Found: C,49.24, H,3.37.

4e: 55% yield; b.p. 94°C/5 mmHg; IR (film): 1720(s) $cm^{-1}$; $^{1}H$ NMR ($CDCl_3$): δ 0.60-1.90(m,9H); 2.71(t,2H,J=7Hz); $^{19}F$ NMR ($CDCl_3$): δ 62.6-63.5(m,2F); 71.6-73.0(m,1F); 81.0-82.2(m,2F) ppm; MS m/e: 266($M^+$), 195($M^+-C_5H_{11}$). Analysis: Calcd for $C_{12}H_{11}F_5O$: C,54.14, H,4.17; Found: C,54.92, H,4.51.

4f: 53% yield; b.p. 116°C/6 mmHg; IR (film): 1710(s) $cm^{-1}$; $^{1}H$ NMR ($CDCl_3$): δ 0.68-1.99(m.9H); 2.78(t,2H,J=7Hz); $^{19}F$ NMR($CDCl_3$): δ 59.6-60.7(m,2F);61.9-63.0(m,2F) ppm; MS m/e: 282($M^+$), 211($M^+-C_5H_{11}$). Analysis: Calcd for $C_{12}H_{11}ClF_4O$: C,50.99, H,3.92, Found: C,50.47, H,3,78.

4g: 54% yield; b.p.135°C/10 mmHg; IR (film): 1720(s) $cm^{-1}$; $^{1}H$ NMR ($CDCl_3$): δ 0.63-1.87(m,13H); 2.78(t,2H,J=7Hz); $^{19}F$ NMR ($CDCl_3$): δ 62.2-63.7(m,2F); 72.0-73.0(m,1F); 81.8-82.9(m,2F) ppm. MS m/e: 294($M^+$), 195($M^+-C_7H_{15}$). Analysis: Calcd for $C_{14}H_{15}F_5O$: C,57.14, H,5.14, Found: C,57.22, H,5.07.

4h: 51% yield; b.p. 150°C/10 mmHg; IR(film): 1720(s) $cm^{-1}$; $^{1}H$ NMR ($CDCl_3$): δ 0.71-1.85(m,13H); 2.78(t,2H,J=7Hz); $^{19}F$ NMR($CDCl_3$): δ 59.3-60.5(m,2F);61.7-63.0(m,2F) ppm; MS m/e: 311($M^+$+1),211($M^+-C_7H_{15}$). Analysis: Calcd for $C_{14}H_{15}ClF_4O$: C,54.12, H,4.87, Found: C,53.86, H,5.49.

ACKNOWLEDGEMENT

The authors wish to thank the National Science Foundation of China for financial support.

REFERENCES

1 T.N. Gerasimova, T.V. Fomenko and E.P. Fokin, Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Khim. Nauk, 5, (1975) 100; C.A., 84 (1976) 16902r.

2 A.F. Webb and H. Gilman, J. Organometall. Chem., 20 (1969) 281.

3 H.J. Bestmann and O. Kratzer, Chem. Ber., 96 (1963) 1899.

4 F. Ramirez, R.B. Mitra and N.B. Desai, J. Am. Chem. Soc., 82 (1960) 5763.

5 N.A. Nesmeyanov, S.T. Berman and O.A. Reutov, Izv. Akad. Nauk SSSR Ser. Khim., 3 (1972) 605; C.A., 77 (1972) 101784d.