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A facile conversion of aryl alkyl ketones into methyl 2-arylalkanoates using poly[4-(diacetoxyiodo)styrene]

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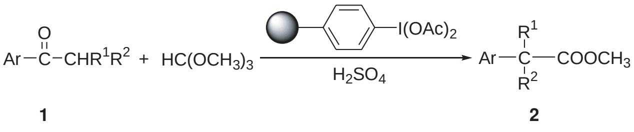
Treatment of aryl alkyl ketones with poly[4-(diacetoxyiodo)styrene] and trimethyl orthoformate in the presence of sulfuric acid followed by hydrolysis afforded methyl 2-arylalkanoates in good yields. The polymeric reagent can be regenerated and reused as an environmentally benign reagent.

Keywords: poly[4-(diacetoxyiodo)styrene], aryl alkyl ketones, methyl 2-arylalkanoates, synthesis.

2-Arylalkanoic acids and derivatives have found widespread use as anti-inflammatory agents,[1] and are normally prepared from aryl alkyl ketones by the Willegerodt-Kindler reaction.[2] However, this synthetic utility is seriously limited by the necessity of elevated reaction temperatures and frequently high pressure, coupled with the moderate yields. Other improved methods for their preparation involve using more or less toxic reagents such as thallium(III) nitrate,[3] silver carbonate,[4] silver(I) nitrate/iodine,[5] iodine monochloride[6] and lead(IV) acetate,[7] *etc*. Phenyliodine diacetate (PID) is widely used in organic synthesis with the combined advantages of mild reaction conditions, easy handling, high selectivity and low toxicity.[8] Tamura *et al.*[9] reported that PID could be used to prepare methyl 2-arylpropanoates. But PID has a major shortcoming: the iodobenzene formed is difficult to separate from the product and is hard to reuse. We have recently found that the use of poly[4-(diacetoxyiodo)styrene][10] could overcome these problems. Herein, we describe the facile preparation of methyl 2-arylalkanoates from aryl alkyl ketones using poly[4-(diacetoxyiodo)styrene] as shown in Scheme 1.

Poly[4-(diacetoxyiodo)styrene] was prepared from commercial polystyrene (MW = 45,000) according to the literature method.[10] Treatment of aryl alkyl ketones **1** with poly[4-(diacetoxyiodo)styrene] and trimethyl orthoformate in acetonitrile at 60 °C in the presence of sulfuric acid followed by hydrolysis yielded methyl 2-arylalkanoates **2**. This 1,2-aryl migration reaction was not confined to acetophenone. A range of higher homologues and ring-substituted analogues could be converted into the corresponding esters in good yields. Representative examples are listed in Table 1. After the reaction with poly[4-(diacetoxyiodo)styrene], the formed poly(4-iodostyrene) was nearly quantitatively recovered by simple filtration on addition of water. The recovered poly(4-iodostyrene) was again oxidised with peracetic acid to afford poly[4-(diacetoxy)iodo]styrene. To show the reactivity of the regenerated polymeric reagent, the conversion of acetophenone (**1a**) into methyl phenylacetate (**2a**) was repeated four times using the same batch of poly[4-(diacetoxy)iodo]styrene regenerated after each reaction. As seen from Table **1** (Entry 9), the yield of **2a** remained almost same as when the first prepared poly[4-(diacetoxy)iodo]styrene was used.

In conclusion, poly[4-(diacetoxy)iodo]styrene has good reactivity for the conversion of aryl alkyl ketones into methyl 2-arylalkanoates; moreover, the polymeric reagent can be regenerated and reused as an environmentally benign reagent.



Scheme 1

Table 1 Conversion of aryl alkyl ketones into methyl 2-arylalkanoates with resin-bound PID

Entry	Ar	R[1]	R[2]	Product	Yield/%[a]
1	C_6H_5	H	H	2a	80
2	4-$CH_3C_6H_4$	H	H	2b	82
3	4-$CH_3OC_6H_4$	H	H	2c	86
4	4-BrC_6H_4	H	H	2d	80
5	1-naphthyl	H	H	2e	80
6	C_6H_5	H	CH_3	2f	85
7	C_6H_5	H	CH_2CH_3	2g	83
8	C_6H_5	CH_3	CH_3	2h	81
9	C_6H_5	H	H	2a [b]	79

[a]Isolated yield; [b]By using poly[4-(diacetoxy)iodo]styrene recycled for 4 times.

Experimental

Polystyrene (MW=45000) was purchased from Aldrich. Melting points were uncorrected; ^{1}H NMR spectra were recorded on Bruker Avance 400 MHz spectrometer using $CDCl_3$ as the solvent and with TMS as internal standard; IR spectra were determined on a Perkin-Elmer SP One FT-IR spectrophotometer. Poly[4-(diacetoxy)iodo]styrene containing 1.85 mmol/g of functional group by elemental analysis was prepared according to the reported method.[10]

General procedure for preparation of methyl 2-arylalkanoates **2***:* To a stirred solution of aryl alkyl ketone **1a–1h** (1.0 mmol) and poly[4-(diacetoxy)iodo]styrene (1.5 mmol) in trimethyl orthoformate (3 ml) and acetonitrile (6 ml) was added sulfuric acid (0.20 g, 2.0 mmol) dropwise at room temperature. The mixture was heated at 60 °C for 30 min, then cooled to room temperature, quenched with water (30 ml) and the solution was filtered. The formed poly (4-iodostyrene) was recovered as a solid nearly quantitatively after being washed with ether (2×3 ml). The filtrate was extracted with ether (2×10 ml), washed with water and dried with magnesium sulfate. The solvent was evaporated under reduced pressure and the residue was purified by column chromatography on silica gel using hexane/ethyl acetate (30/1) as eluent to give pure product.

Methyl phenylacetate (**2a**)[3b]: oil, ^{1}H NMR δ 7.02–7.10 (m, 2H), 7.15–7.20 (m, 3H), 3.68 (s, 3H), 3.60 (s, 2H); IR ($\nu_{C=O}$) 1732 cm^{-1}.

Methyl p-methylphenylacetate (**2b**)[3b]: oil, ^{1}H NMR δ 7.10 (d, J = 7.9 Hz, 2H), 7.50 (d, J = 7.9 Hz, 2H), 3.70 (s, 3H), 3.66 (s, 2H), 2.32 (s, 3H); IR ($\nu_{C=O}$) 1731 cm^{-1}.

Methyl p-methoxylphenylacetate (**2c**)[3b]: oil, ^{1}H NMR δ 7.15 (d, J = 8.1 Hz, 2H), 7.60 (d, J = 8.1 Hz, 2H), 3.78 (s, 3H), 3.65 (s, 2H), 3.61 (s, 3H); IR ($\nu_{C=O}$) 1730 cm^{-1}.

Methyl p-bromophenylacetate (**2d**)[3b]: M.p. 113–114°C (lit. 113–114 °C), ^{1}H NMR δ 7.25 (d, J = 8.3 Hz, 2H), 7.67 (d, J = 8.3 Hz, 2H), 3.55 (s, 2H), 3.62 (s, 3H); IR ($\nu_{C=O}$) 1733 cm^{-1}.

Methyl 1-naphthylacetate (**2e**)[5]: oil, ^{1}H NMR δ 7.25–7.95 (m, 7H), 3.66 (s, 2H), 3.60 (s, 3H); IR ($\nu_{C=O}$) 1728 cm^{-1}.

Methyl 2-phenylpropanoate (**2f**)[5]: oil, ^{1}H NMR δ 7.05–7.28 (m, 5H), 3.71 (q, J = 7.1 Hz, 1H), 3.61 (s, 3H), 1.49 (d, J = 7.1 Hz, 3H); IR ($\nu_{C=O}$) 1730 cm^{-1}.

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Methyl 2-phenylbutyrate (**2g**)[5]: oil, ^{1}H NMR δ 7.06–7.30 (m, 5H), 3.63 (s, 3H), 3.57 (t, *J* = 6.9 Hz, 1H), 1.98 (m, 2H), 0.92 (t, *J* = 7.1 Hz, 3H); IR ($\nu_{C=O}$) 1732 cm^{-1}.

Methyl 2-methyl-2-phenylpropanoate (**2h**)[5]: oil, ^{1}H NMR δ 7.05–7.32 (m, 5H), 3.56 (s, 3H), 1.56 (s, 6H); IR ($\nu_{C=O}$) 1732 cm^{-1}.

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References

1 E.V. Brown, *Synthesis*, 1975, 358.
2 (a) M. Carmack and M.A. Spielman, *Org. React.*, 1974, **3**, 83; (b) F. Asinger, W. Schafer and K. Halcour, *Angew. Chem. Int. Ed. Engl.*, 1964, **3**, 19; (c) R. Wegler, E. Kühle and W. Schäfer, *Newer methods of preparative organic chenmistry*, Vol. 3, Academic Press, New York, 1964, 1.
3 (a) B.P. Swann and E.C. Taylor, *J. Am. Chem. Soc*., 1973, **95**, 3340; (b) E.C. Taylor, C.-S. Chiang, A. McKillop and J.F. White, *J. Am. Chem. Soc*., 1976, **98**, 6750.
4 C. Giordano, G. Castaldi, F. Casagrande and L. Abis, *Tetrahedron Lett.*,1982, **23**, 1385.
5 S.D. Higgins and C.B. Thomas, *J. Chem. Soc. Perkin Trans. 1*, 1982, 235.
6 A. Goosen and C.W. McCleland, *J. Chem. Soc. Chem, Commun.*, 1982, 1311.
7 (a) B. Myrboh, H. Ila and H, Junjappa, *Synthesis*, 1981, 126; (b) K, Fujii, K. Nakao and T. Yamauchi, *Synthesis*, 1982, 456.
8 (a) P.J. Stang, *Chem. Rev.*, 1996, **96**, 1123; (b) A. Varvoglis, *Chem. Soc. Rev.*, 1981, **10**, 377.
9 Y. Tamura, Y. Shirouchi and J.-I. Haruta, *Synthesis*, **1984**, 231.
10 S. Abe, K. Sakuratani and H. Togo, *J. Org. Chem.*, 2001, **66**, 6174.