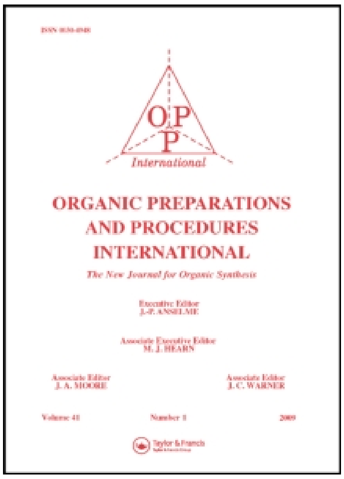


Organic Preparations and Procedures International
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t902189982

A CONVENIENT PREPARATION OF DIPHENYLMETHANES FROM BROMOBENZENES USING THE GRIGNARD CROSS-COUPLING REACTION

Takehiko Yamato[a]; Naozumi Sakaue[a]; Kazuaki Suehiro[a]; Masashi Tashiro[b]
[a] Department of Industrial Chemistry, Faculty of Science and Engineering, Saga University, Saga, JAPAN [b] Department of Molecular Science and Technology Graduate School of Engineering Sciences, Research Institute of Advanced Material Study, Kyushu University, Fukuoka, JAPAN

To cite this Article Yamato, Takehiko , Sakaue, Naozumi , Suehiro, Kazuaki and Tashiro, Masashi(1991) 'A CONVENIENT PREPARATION OF DIPHENYLMETHANES FROM BROMOBENZENES USING THE GRIGNARD CROSS-COUPLING REACTION', Organic Preparations and Procedures International, 23: 5, 617 — 620

To link to this Article: DOI: 10.1080/00304949109457913

URL: http://dx.doi.org/10.1080/00304949109457913

ORGANIC PREPARATIONS AND PROCEDURES INT., 23 (5), 617-620 (1991)

A CONVENIENT PREPARATION OF DIPHENYLMETHANES FROM BROMOBENZENES USING THE GRIGNARD CROSS-COUPLING REACTION

Takehiko Yamato*[†], Naozumi Sakaue[†], Kazuaki Suehiro[†] and
Masashi Tashiro[††]

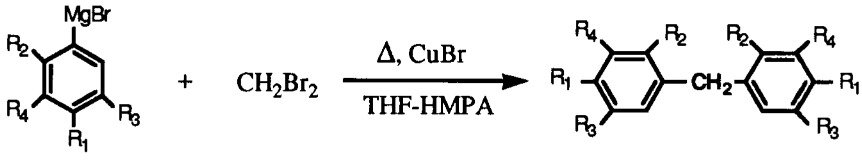
[†]Department of Industrial Chemistry,
Faculty of Science and Engineering
Saga University, Honjo-machi, Saga-shi, Saga 840, JAPAN

[††]Research Institute of Advanced Material Study
and Department of Molecular Science and Technology
Graduate School of Engineering Sciences
Kyushu University, 6-1 Kasuga-kohen, Kasuga-shi
Fukuoka 816, JAPAN

Friedel-Crafts benzylation reactions to prepare diphenyl- methanes sometimes give complex reaction mixtures because of the increased tendency of the benzylated products towards further benzylation and isomerization.[1] Therefore, there are numerous reports on the reduction of benzophenones using hydroalanes[2], sodium borohydride and triethylsilane in the presence of Brönsted or Lewis acids.[3-6] However, not only do these methods require long reaction times, but sterically hindered aryl ketones or arylketones bearing electron-deficient groups afford only low yields of diphenylmethanes together with alcohols, or no reduction products. Furthermore, although many examples of the construction of the diphenylmethane linkage using organometallics have been reported, the preparation and handling of the catalyst is somewhat inconvenient, and reactions were of limited scope.[7-9] We previously reported a convenient preparation of diphenylmethanes using Grignard cross-coupling reaction of arylmagnesium bromide with benzyl chlorides in the presence of cuprous bromide as a catalyst.[10] This method, however, is limited to the availablity of the required benzyl chloride. We now report a more convenient, one-step preparation of diphenylmethanes from bromobenzenes.

The cross-coupling reaction of arylmagnesium bromide (**1**) with dibromomethane (**2**) was carried out in the presence of cuprous bromide as a catalyst in hexamethylphosphorous triamide (HMPA) solution. The reactions were completed within 2 hours. Compound **3** was obtained in good to excellent yields (60-90%) in all cases. The present method provides very good to excellent yields, and the preparation and handling of the CuBr catalyst is much more convenient than the previous methods.[7-9]

Although 2,2'-bis(hydroxymethyl)diphenylmethane has been already prepared by Sato and his co-workers in low yield starting from 2-iododiphenylmethane, the route used was too long for practical purposes.[11] It is difficult to apply our previously reported Grignard cross-coupling reaction of arylmagnesium bromide with benzyl chlorides to prepare diphenylmethane (**3e**),[10] because the starting benzyl chloride, 2-methoxymethylbenzyl chloride is difficult to obtain. However, the present Grignard cross-coupling reaction of arylmagnesium bromide (**1e**) with dibromomethane (**2**) afforded the desired diphenylmethane (**3e**) in 60% yield.



1 **2** **3**

a) R_1 = Me, R_2,R_3,R_4 = H (83)
b) R_1 = *t*-Bu, R_2,R_3,R_4 = H (86)
c) R_1 = H, R_2 = Me, R_3 = *t*-Bu, R_4 = H (85)
d) R_1 = H, R_2 = OMe, R_3 = *t*-Bu, R_4 = H (90)
e) R_1,R_3,R_4 = H, R_2 = CH_2OMe (60)
f) R_1 = Me, R_2 = H, R_3,R_4 = Me (63)
g) R_1,R_3 = OMe, R_2,R_4 = H (70)

Furthermore, it is difficult to prepare 3,5-dimethyl-4-methoxybenzyl chloride and 3,4-dimethoxybenzyl chloride by direct chloromethylation of the corresponding aromatic compounds, because further of benzylation and of trimerization to 3,3',5,5'-tetramethyl-4,4'-dimethoxydiphenylmethane[12] and cyclotriveratrylene,[13,14] respectively. However, the present method does not require the preparation of reactive chloromethylated starting materials to afford the desired diphenylmethanes (**3f**) and (**3g**) in 63% and 70% yield, respectively.

Consequently, the present Grignard cross-coupling reactions offer advantages over previously reported Friedel-Crafts benzylation methods because undesired benzylation or isomerization did not occur, resulting in very good to excellent yields and easy isolation of the products.

EXPERIMENTAL SECTION

All melting points are uncorrected. ^1H NMR spectra were recorded on Nippon Denshi JEOL FT-270 NMR spectrometer in deuteriochloroform with Me_4Si as an internal reference. IR spectra were measured as KBr pellets or as liquid films on NaCl plates in a Nippon Denshi JIR-AQ2OM spectrometer. Mass spectra were obtained on a Nippon Denshi JMS-01SA-2 spectrometer at 75 eV using a direct inlet system.

General Procedure for the Grignard Cross-coupling to Diphenylmethanes (**3**).- To a mixture of magnesium (3.4 g, 143 mmol) and iodine (50 mg) in THF (5 mL) was added dropwise a solution of bromobenzenes (70 mmol) in THF (50 mL). The mixture was heated at reflux for 12 hrs. To a solution of dibromomethane (**2**) (30 mmol) and CuBr (1 g, 7.0 mmol) in HMPA (8 mL) was added dropwise the solution of the Grignard reagent under gentle reflux. After heating to reflux for an additional 2 hrs, the reaction mixture was quenched with 10% aqueous ammonium chloride (200 mL). The mixture was extracted with CH_2Cl_2 (200 mL) and the extract was washed with water (200 mL), dried (Na_2SO_4) and concentrated at reduced pressure to leave a residue, which was recrystallized or distilled under a reduced pressure.

4,4'-Dimethyldiphenylmethane (**3a**), colorless liquid, bp. 122-124°/3mmHg, lit.[15] bp. 165°/12mmHg.

4,4'-Di-*tert*-butyldiphenylmethane (**3b**), colorless prisms, (EtOH), mp. 70-71°, lit.[16] mp. 70-71°.

2,2'-Dimethyl-5,5'-di-*tert*-butyldiphenylmethane (**3c**), colorless liquid, bp. 164°/3mmHg, lit.[12] bp. 162-163°/12mmHg.

2,2'-Dimethoxy-5,5'-di-*tert*-butyldiphenylmethane (**3d**), colorless prisms (hexane), mp. 80-82°, lit.[16] mp. 80-82°.

2,2'-Bis(methoxymethyl)diphenylmethane (**3e**), colorless prisms (methanol), mp. 40-42°, IR (KBr): 2915, 2883, 2872, 2822, 2806, 1465, 1455, 1434, 1385, 1196, 1115, 1086, 1047, 973, 750 cm^{-1}; NMR ($CDCl_3$): δ 3.36 (6H, s), 4.11 (2H, s), 4.42 (4H, s), 6.91-6.95 (2H, m), 7.16-7.25 (4H, m), 7.35-7.39 (2H, m); Mass spectrum: m/e 256 (M^+).

Anal. Calcd. for $C_{17}H_{20}O_2$: C, 79.65; H, 7.86. Found: C,79.80; H, 8.09

3,3',5,5'-tetramethyl-4,4'-dimethoxydiphenylmethane (**3f**), colorless prisms (hexane), mp. 90-100°, lit.[17] mp. 99-99.5°.

3,3',4,4'-tetramethoxydiphenylmethane (**3g**), colorless prisms (hexane), mp. 72-73°, lit.[18] mp. 70-71°.

REFERENCES

1. G. A. Olah, "*Friedel-Crafts Chemistry*", Wiley-Interscience, New York, 1973.
2. J. Blackwell and W. J. Hickinbottom, *J. Chem. Soc.*, **1961**, 1405.
3. G. W. Gribble, W. J. Kelly and S. E. Emery, *Synthesis*, 763 (1978).
4. G. W. Gribble and C. F. Nutaitis, *Org. Prep. Proced. Int.*, **17**, 317 (1985).
5. G. A. Olah, M. Arvanaghi and L. Ohannesian, *Synthesis*, 770 (1986).
6. J. L. Fry and M. A. McAdam, *Tetrahedron Lett.*, 5859 (1984).
7. K. Omura and H. Hashimoto, *Bull. Chem. Soc. Jpn.*, **45**, 2582 (1972).
8. K. Omura, J. Yamashita and J. Hashimoto, *ibid.*, **43**, 836 (1970).
9. J. K. Kochi and J. W. Powers, *J. Am. Chem. Soc.*, **92**, 137 (1970).

10. T. Yamato, S. Nagayama, K. Maeda and M. Tashiro, *Chem. Express*, **5**, 637 (1990); *C. A.*, **114**, 23456q (1991).

11. T. Sato and K. Uno, *J. Chem. Soc. Perkin I*, **1973**, 895.

12. M. Tashiro and G. Fukata, *J. Org. Chem.*, **42**, 1208 (1977).

13. A. S. Lindsey, *J. Chem. Soc.*, **1965**, 1685.

14. A. Collet, *Tetrahedron*, **1987**, 5725.

15. *Dictionary of Organic Compounds*, Vol. 3, Oxford University Press, 1965.

16. M. Tashiro, T. Yamato and F. Fukata, *J. Org. Chem.*, **43**, 1413 (1978).

17. W. Baker, J. W. Barton, J. F. W. McOmie, R. J. Penneck and M. L. Watts, *ibid.*, **1961**, 3986.

18. J. D. White, and B. D. Gesner, *Tetrahedron*, **30**, 2273 (1974).

(Received April 30, 1991; in revised form July, 15 1991)