A Convenient Synthesis of Benzo[s]picene

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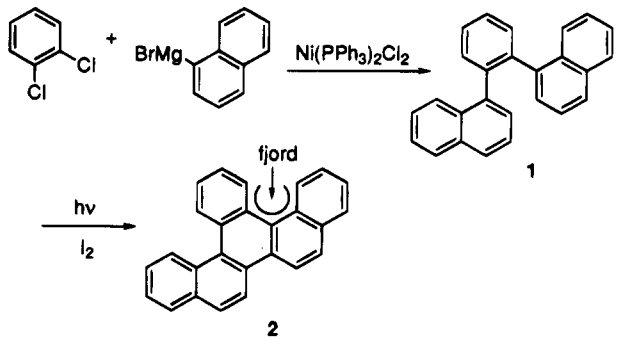
Despite its relatively simple structure, the five-ring polycyclic aromatic hydrocarbon benzo[s]picene is relatively underinvestigated. It is not cited in Clar's two volume book on polycyclic hydrocarbon chemistry,[1] nor in the more recent volume by Harvey,[2] nor have there been any reports of its electrophilic substitution. One reason for neglect is the deficiency of convenient synthetic methods.[3-5] Our interest in this molecule was stimulated by the fact that it contains two *fjord* regions, a structural feature expected to cause deviation from planarity.[6-9] Recent biological studies have shown that some of the most potent carcinogenic polycyclic hydrocarbons, e.g. benzo[g]chrysene and dibenzo[a,l]pyrene, contain a *fjord* region.[9,10] The potential carcinogenicity of benzo[s]picene has not been investigated.

We report a convenient two step synthesis of benzo[s]picene from readily available materials (Scheme 1). The method entails initial coupling between *o*-dichlorobenzene and the Grignard reagent of 1-bromonaphthalene catalyzed by the nickel(II) chloride triphenylphosphine complex, $Ni(PPh_3)_2Cl_2$, to form the 1,2-dinaphthyl derivative of benzene (**1**). Oxidative photocyclization of **1** in the presence of I_2 takes place smoothly to provide pure benzo[s]picene (**2**) in 77% overall yield (79% in step one and 98% in step two). In principle, this method is adaptable to the synthesis of a wide range of derivatives of benzo[s]picene.

The symmetrical structure of benzo[s]picene coupled with its probable nonplanarity as a consequence of steric interference between the hydrogen atoms in the *fjord* regions[6] confers on it the potential for forming novel stereoisomers, i.e. an optically inactive isomer in which the outer rings are roughly coplanar and above the plane of the central benzo ring, and a pair of enantiomers in which one outer ring is above the central benzo ring while the second outer ring is below the central benzo ring.

Scheme 1



Experimental Section

1,1'-Bis(1,2-phenylene)naphthalene (1). To an ultrasonically irradiated mixture of magnesium turnings (483 mg, 20 mmol) and a crystal of iodine in dry ethyl ether (20 mL) under argon was added dropwise a solution of 1-bromonaphthalene (2.50 g, 12 mmol) in ether (20 mL) over a 0.5 h period. During the addition the temperature of the water bath increased due to sonication and maintained the reaction at rapid reflux. After addition was complete, sonication was continued for another 2 h to ensure complete consumption of the 1-bromonaphthalene. The Grignard reagent, which was obtained as a pale yellow slurry, was dissolved by the addition of dry benzene (50 mL), transferred to a dropping funnel by means of a cannula, and added dropwise to a stirred solution of 1,2-dichlorobenzene (588 mg, 4 mmol) and $Ni(PPh_3)_2Cl_2$ (121 mg) in 50 mL of dry benzene at room temperature over 1 h. The solution was stirred overnight, more $Ni(PPh_3)_2Cl_2$ (95 mg) was added, and the reaction mixture was refluxed overnight. The mixture was cooled in an ice bath and hydrolyzed with 2 N HCl (50 mL). The organic layer was separated, and the aqueous layer was extracted with ether. The organic layer combined with the ether extracts was washed successively with water, saturated $NaHCO_3$, and water and dried over Na_2SO_4. After evaporation of the solvent the residue was chromatographed on silica gel eluted with hexane/CH_2Cl_2 (10:1) to give **1** (1.04 g, 79%) as a white solid, mp 155-156 °C (lit.[4] 155 °C); ^1H NMR (500 MHz) ($CDCl_3$) δ 6.83-6.93 (m, 6), 7.37-7.54 (m, 8,), 7.68-7.79 (m, 4).

Benzo[s]picene (2). Argon was bubbled through a stirred solution of **1** (562 mg, 1.70 mmol) and iodine (518 mg) in benzene (500 mL) for 0.5 h; 1,2-epoxybutane[11] (5.0 mL) was added, and the reaction mixture was irradiated with a 450W UV lamp filtered through a Pyrex tube. Argon flow was maintained throughout the procedure. After 6 h the mixture was washed with aqueous $Na_2S_2O_3$ solution, water, and saturated brine and dried over over Na_2SO_4. Evaporation of the solvent left **2** as a white solid (547 mg, 98%), mp 198-199 °C (hexane/ CH_2Cl_2) (lit.[5] 204-205 °C); ^1H NMR (500 MHz) ($CDCl_3$) δ 7.51 (m, 6), 7.92 (d, 2, J = 8.6 Hz), 7.93 (d, 2, J = 7.4 Hz), 8.49 (d, 2, J = 8.8 Hz), 8.85 (dd, 2, J = 6.0, 6.0 Hz), 8.91 (d, 2, J = 8.4 Hz); UV (ethanol) λ_{max} 350 (ϵ 10 800), 334 (18 290), 305 (82 850), 295 (75 100), 275 (95 240), 210 (60 110) nm. The UV spectrum of **2** differed from that reported by Clar et al.[4] While a major peak was found at 295 nm in accord with that reported, the strongest absorption was at 275 nm rather than 283 nm as claimed earlier. This discrepancy is probably due to the greater purity of our sample, which exhibited a sharp melting point and showed no extraneous peaks in the NMR spectrum. The sample obtained by Clar et al. failed to crystallize, and its UV spectrum showed broad, less sharply defined peaks.

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