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Modified Clemmensen reduction of some polycyclic alkylarylketones. Comparison of zinc dust and granulated zinc action.

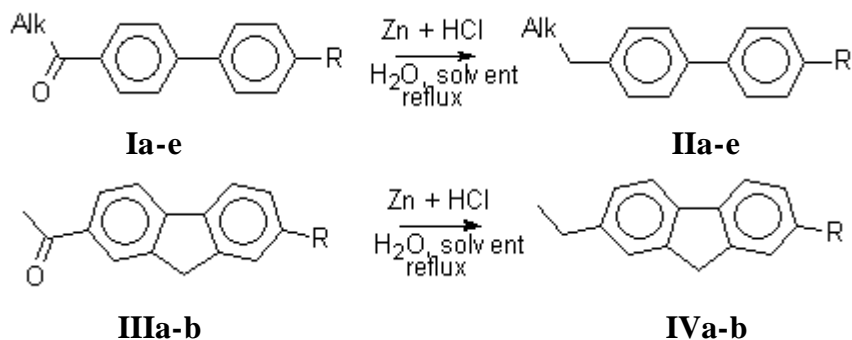
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Abstract. The method for reduction of alkylaryl ketones to alkylarenes with zinc metal instead zinc amalgam was extended for polycyclic arylalkylketones derived from biphenyl and fluorene. The comparison of zinc dust and granulated zinc activity was made.

In course of our investigation directed to replace zinc amalgam for non-amalgamated zinc in Clemmensen reduction of carbonyl group to methylene group we have investigated reduction of some alkylbiphenyl and alkylfluorenyl ketones.



Unsubstituted arylalkylketones were reduced to correspondent alkylarenes with moderate yields. Reactions proceeds more slowly than for alkylphenylketones [1], probably, due to more hydrophobic character of compounds used. Addition of solvent immiscible with water some increases yields, addition of solvents miscible with water increases yields significantly.

Yields of hydroxy-substituted compounds were higher, than for non-phenolic compounds. Addition of solvent miscible with water also increases the yield.

The results of reduction are summarised in Table.

Starting compound	Alk	R	Solvent	Obtained compound	Yield, %	b.p. or m.p., °C	b.p. or m.p. [lit]), °C
Ia	CH ₃	H	- C ₆ H ₅ CH ₃ C ₂ H ₅ OH	IIa	60 72 87, 90*	m.p. 45-47	m.p. 46-47 [2]
Ib	CH ₃	COCH ₃	C ₂ H ₅ OH	IIb R=C ₂ H ₅	90	m.p. 81-83	m.p. 83 [3]
Ic	C ₂ H ₅	H	C ₂ H ₅ OH	IIc	88	m.p. 37-39	m.p. 40 [4]
Id	C ₃ H ₇	H	- C ₂ H ₅ OH	IId	45 83	freezing p. 13-15	m.p. 15.3-16.3, b.p. 128-129 (1mm) [5]
Ie	CH ₃	OH	-	IIe	71	m.p. 148-150	m.p. 151 [6]

			C ₆ H ₅ CH ₃		75		
			C ₂ H ₅ OH		92		
IIIa		H	C ₂ H ₅ OH	IVa	89	m.p. 97-100	m.p. 99.5-100.5 [7]
IIIb		OH	C ₂ H ₅ OH	IVb	93	m.p. 163-165	m.p. 165-166 [8]

* Granulated zinc instead zinc dust was used.

In most of runs we have used zinc dust. For comparison, we have used granulated zinc and zinc dust for reduction **Ia** to **IIa**. We have found that reduction with granulated zinc proceeds during longer time than with zinc dust, no other differences we have observed.

Experimental.

General procedure for reduction of non-phenolic arylalkylketones (Ia, Id) without additional solvent. To 0.1 mol of arylalkylketone and 0.3 mol of zinc dust 50 ml of water and 50 ml of concentrated hydrochloric acid were added. The reaction mixture was heated with reflux condenser at reflux during 24 hr. Each 6 hours 5 ml of concentrated hydrochloric acid was added. The reaction mixture was monitored with TLC. After the end of reaction the reaction mixture was cooled and extracted with ethyl ether. After drying with sodium sulphate, filtration, and removing of solvent the residue purified by crystallisation.

General procedure for reduction of non-phenolic arylalkylketones (Ia) with additional solvent immiscible with water. To 0.1 mol of arylalkylketone and 0.3 mol of zinc dust 50 ml of water, 50 ml of concentrated hydrochloric acid, and 50 ml of solvent were added. The reaction mixture was heated with reflux condenser at reflux during 24 hours. Each 6 hours 5 ml of concentrated hydrochloric acid was added. The reaction mixture was monitored with TLC. After the end of reaction the reaction mixture was cooled, water layer separated and extracted with ethyl ether. Combined organic solutions were dried with sodium sulphate, filtered, and solvents were removed at reduced pressure. The residue purified by crystallisation.

General procedure for reduction of non-phenolic arylalkylketones (Ia, Ib, Ic, Id, IIIa) with additional solvent miscible with water. To 0.3 mol of zinc dust (* granulated zinc, last run of **Ia**), 50 ml of water, 50 ml of solvent, and 50 ml of concentrated hydrochloric acid, heated to gentle boiling, 0.1 mol of arylalkylketone (0.5 mol of **Ib**) solution in 300 ml of solvent were added during 4 hours. The reaction mixture was heated with reflux condenser at reflux during 10-15 hours (* 30 hours, granulated zinc, last run of **Ia**). Each 2 hours 5 ml of concentrated hydrochloric acid was added. The reaction mixture was monitored with TLC. After the end of reaction the reaction mixture was cooled, water layer separated and extracted with ethyl ether. Combined organic solutions were dried with sodium sulphate, filtered, and solvents were removed at reduced pressure. The residue purified by crystallisation.

General procedure for reduction of phenolic arylalkylketones (Ie) without of additional solvent. To 0.1 mol of arylalkylketone and 0.15 mol of zinc dust 25 ml of water and 25 ml of concentrated hydrochloric acid were added. The reaction mixture was heated with reflux condenser at reflux during 5-10 hours. Each hour 2.5 ml of concentrated hydrochloric acid was added. The reaction mixture was monitored with TLC. After the end of reaction the reaction mixture was cooled, saturated with NaCl, and extracted with ethyl ether. After drying with sodium sulphate, filtration, and removing of solvent the residue purified by crystallisation.

General procedure for reduction of phenolic arylalkylketones (Ie) with additional solvent immiscible with water. To 0.1 mol of arylalkylketone and 0.15 mol of zinc dust 25 ml of water, 25 ml of solvent, and 25 ml of concentrated hydrochloric acid were added. The reaction mixture was heated with reflux condenser at reflux during 5-10 hours. Each hour 2.5 ml of concentrated hydrochloric acid was added. The reaction mixture was monitored with TLC. After the end of reaction the reaction mixture was cooled, saturated with NaCl, and extracted with ethyl ether. After drying with sodium sulphate, filtration, and removing of solvent the residue purified by crystallisation.

General procedure for reduction of phenolic arylalkylketones (Ie, IIIb) with additional solvent miscible with water. To 0.1 mol of arylalkylketone and 0.15 mol of zinc dust 25 ml of water, 25ml of solvent, and 25 ml of concentrated hydrochloric acid were added. The reaction mixture was heated with reflux condenser at reflux during 4-5 hr. Each hour 2.5 ml of concentrated hydrochloric acid was added. The reaction mixture was monitored with TLC. After the end of reaction the reaction mixture was cooled, saturated with NaCl, and extracted with ethyl ether. After drying with sodium sulphate, filtration, and removing of solvent the residue purified by crystallisation.

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