

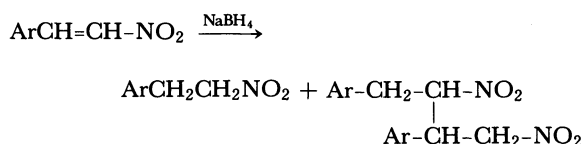
Reduction of Nitrostyrenes to Nitroalkanes with a NADH Grafted Model

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Synopsis. Grafting of the 1,4-dihydronicotinamide structure on a Merrifield type resin is described. With this reagent, aryl nitroethanes have been obtained by regioselective reduction of β -nitrostyrenes. The yields are good and no dimeric compounds are formed. The role of magnesium ions in these reductions is different from that observed with classical NADH models.

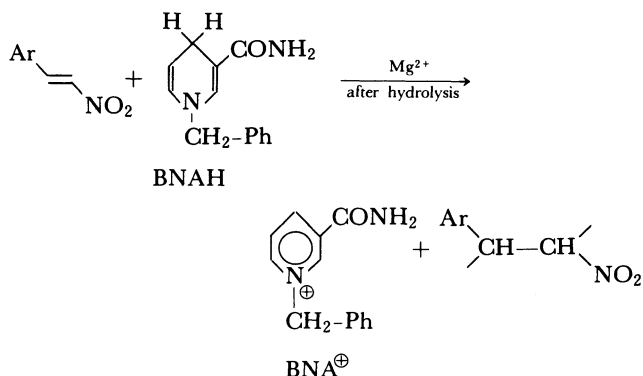
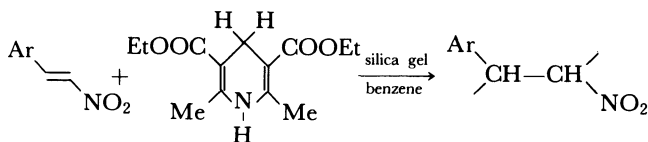
Arylnitroethanes are compounds of special interest since they are useful synthetic intermediates. The nitro group can be converted to other functional groups such as carbonyl, nitrile oxides, or amino group.

A widely used method to obtain 2-aryl-1-nitroethanes involves reduction of nitrostyrenes. Selective reduction of the ethylene double bond is rather difficult: borohydride reduction under various conditions often leads to contamination of the desired product by side reactions: for example a dimeric compound can be formed by Michael addition of the nitronate intermediate to the starting nitroalkene.¹⁾



Recently some improvements to the usual procedure led the authors to better results.²⁾

Other reagents have been used to ensure selective reduction of the ethylenic double bond of nitrostyrenes, for example NADH models such as 1,4-dihydronicotinamide derivatives or Hantzsch ester. With this last reagent good results in the reduction of various nitroolefins in the presence or silica gel have been reported.³⁾



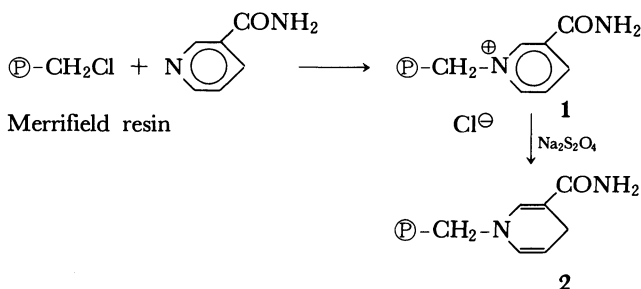
With 1,4-dihydronicotinamide derivatives there are few examples of such reductions⁴⁾ and the yields are rather poor. Moreover it was established that β -nitrostyrene is not reduced in the absence of magnesium ions.^{4a)}

The work-up of reactions performed with BNAH is not easy. It is rather difficult to isolate the desired product from starting reagents or other products formed during the reduction.

Grafting reagents on to an insoluble matrix can constitute an elegant way of resolving the practical problems encountered with free reagents.⁵⁾ A few NADH grafted models have been studied.⁶⁾ In our laboratory we have synthesized the first truly reactive polymer-bound NADH model.⁷⁾ With this reagent excellent results are obtained in the reduction of activated carbonyl compounds.⁷⁾

In this publication we describe the optimisation of the synthesis of the grafted reagent on a Merrifield type resin and its use in the reduction of aryl nitro olefins.

Preparation of Grafted Reagent. The reagent is obtained by reaction of the halomethylated copolymer styrene and divinylbenzene resin with nicotinamide (Scheme 1). The pyridinium salt is just filtered, not dried, before being subjected to regioselective 1,4-reduction with $\text{Na}_2\text{S}_2\text{O}_4$. If the polymer-bonded pyridinium salt **1** is quite free of the solvent used during the quaternarization (CH_3CN), wetting of the polymer does not occur and reaction of $\text{Na}_2\text{S}_2\text{O}_4$ becomes impossible.



The reduction of **1** is complete as shown by the absence of chlorine in the analysis of **2**.

Reduction of Nitrostyrenes. With BNAH, reduction of a substrate in the presence of magnesium ions usually occurs in acetonitrile as solvent. With the reagent **2** we observed that in this solvent the polymer matrix did not swell and consequently no reduction occurred. The access to the active site of the polymer bonded reagent is probably impossible. A swelling cosolvent is needed which also ensures the solubility of Mg^{2+} ions. Finally the best results were obtained in a benzene-acetonitrile (1/1) mixture. In typical conditions [grafted NADH model 1.2 milliequivalent, $\text{Mg}(\text{ClO}_4)_2$ 1 mmol, nitrostyrene 1 mmol, solvents 14 ml, 5 d, 80°C] the results were as follows:

Reduction of Nitrostyrenes. In a dry glass tube 1.2 meq of grafted reagent **2**, 250 mg of $\text{Mg}(\text{ClO}_4)_2$ (1 mmol), 1 mmol of nitrostyrene, 7 ml of hyperdry benzene and 7 ml of hyperdry acetonitrile were introduced under an argon

atmosphere. The tube was sealed, then heated at 80°C for 5 d. After cooling the tube was broken. The resin is discarded, washed with acetonitrile, and water (1 ml) was added. The solvents were evaporated. The residue was extracted with water, then extracted with chloroform. After evaporation of the solvent the pure aryl nitroethanes were recovered.

The aryl-2-nitroalkanes have the characteristics given on the precedent page.

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