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Spotlight 80

This feature focuses on a reagent chosen by a postgraduate, highlighting the uses and preparation of the reagent in current research

Potassium Fluoride on Alumina (KF/Al_2O_3)

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Introduction

Potassium fluoride on alumina (KF/Al_2O_3) is a versatile base developed by Ando et al. for alkylation reactions.[1] Over the years the reagent has found applications in a large number of organic reactions such as elimination,[2] addition,[3] condensation,[4] epoxidation,[5] palladium-catalyzed coupling[6] and the synthesis of heterocyclic compounds.[7] The KF/Al_2O_3 system has been able to replace organic bases in many reactions, but still its enhanced source of basicity as compared to non-supported KF remains a matter of debate in literature.[8] Recently, Blass has reviewed[9] KF/Al_2O_3 mediated organic synthesis.

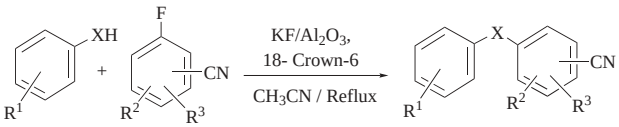
The solid supported reagent has the advantage of being used in solid and solution phase reactions thus facilitating ease of separation from reaction mixture by filtration. In addition, it can be conveniently used for microwave and ultrasound mediated chemical transformations.

Preparation of KF/Al_2O_3

KF/Al_2O_3 is commercially available as a 40 wt.% on alumina. It can also be prepared[2] by mixing alumina to a KF solution in water and then drying under vacuum at 50–60 °C so as to impregnate the alumina. The traces of moisture are finally removed by drying at 75 °C for several hours under high vacuum.

Abstracts

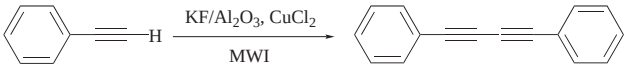
(A) Sawyer et al. have demonstrated the use of KF/Al_2O_3 and 18-Crown-6 to synthesize diaryl ethers, diarylthio ethers, and diaryl amines via S_NAr type addition reaction of phenol, thiophenol, and aniline to 2-fluorobenzonitrile respectively. The optimization of the above reaction conditions led to the synthesis of compounds, which were unachievable using Ullman coupling. For example, electronically unfavorable 3-chloro benzonitrile can be condensed with 3-methylphenol to give corresponding diaryl ether in 66% yields using KF/Al_2O_3, 18-Crown-6 in DMSO at 140 °C.[10]



X = O, S, NH, NMe
R^1 = H, 3-OMe, 2-Cl, 4-NO_2, 4-COOMe, 2-*t*-butyl, 4-*t*-butyl
R^2 = H, 3'-OMe, 6'-Cl, 3'-NMe_2
R^3 = H, 6'-CHO

70–99 %
(21 Examples)

(B) Glaser coupling reactions to generate diacetylenes using KF/Al_2O_3 with $CuCl_2$ and solvent free conditions under microwave irradiation have been optimized by Kabalka et al. The use of two different alkynes, however gives a mixture of products.[11]



75 %
(7 Examples)

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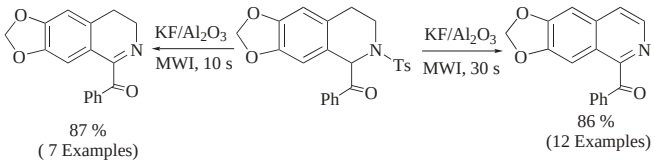
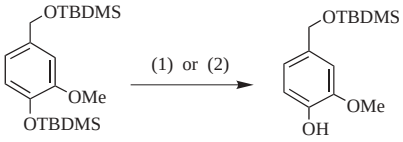
(C) Silveira et al. have reported the use of KF/Al_2O_3 for the synthesis of 3,4-dihydroisoquinolines and isoquinolines by desulfonylation of *N*-sulfonyltetrahydroisoquinone derivatives. Microwave irradiation (490 W) of the solid-state reaction mixture containing the substrate and base for 10–20 s gives 3,4-dihydroisoquinoline, which on increasing the time leads to the formation of corresponding isoquinoline.[12]

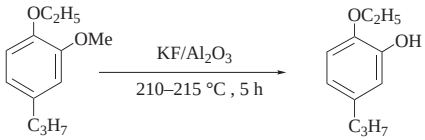


(D) KF/Al_2O_3 selectively desilylates the *tert*-butyldimethylsilyl protected phenol at room temperature. Acetonitrile as the solvent eliminates the need for an aqueous work up and the use of ultrasound accelerates the reaction thereby reducing reaction times.[13]



(1) 3 wt. equiv. KF/Al_2O_3, CH_3CN, r.t., 96 h. 78 % (7 Examples)
(2) 3 wt. equiv. KF/Al_2O_3, CH_3CN, Ultrasound, 4 h. 73 % (6 Examples)

(E) Selective *O*-demethylation of arylalkyl ethers has also been accomplished using KF/Al_2O_3 and dry ethylene glycol in 3–5 h at 210–215 °C in moderate to high yields.[14]



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