Silica Supported Phosphomolybdic Acid: An Efficient Heterogeneous Catalyst for Friedlander Synthesis of Quinolines

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Silica supported phosphomolybdic acid, an eco-friendly heterogeneous catalyst, has been found to be highly efficient for Friedlander synthesis of quinolines in excellent yields. A variety of ketones afford the quinolines smoothly. The catalyst can be easily recovered and reused.

Key words Friedlander synthesis; quinoline; silica supported phosphomolybdic acid; heterogeneous catalyst

Quinoline moiety is frequently found in natural products and bioactive compounds. Various quinolines are known to possess different important medicinal properties such as antimalarial, antibacterial and tyrosine kinase inhibiting activities. Quinolines are also employed for the synthesis of nano- and meso-structures having enhanced electronic and photonic properties. A straight-forward method for the nano- and meso-structures having enhanced electronic and photonic properties. A straight-forward method for the synthesis of quinolines is the Friedlander annulation. This reaction involves the base or acid catalyzed or thermal condensation between a 2-aminoaryl ketone and another carbonyl compound having a reactive α-methylene group followed by cyclodehydration. However, under thermal or base catalysis conditions 2-aminobenzophenone could not react with cyclohexanone and β-keto esters while under acid catalysis conditions side products were formed. Lewis acids such as ZnCl2, Bi(OTf)3, Sc(OTf)3, AuCl3 and ionic liquids have photonic properties. A straight-forward method for the nano- and meso-structures having enhanced electronic and photonic properties. A straight-forward method for the nano- and meso-structures having enhanced electronic and photonic properties. A straight-forward method for the nano- and meso-structures having enhanced electronic and photonic properties.

In recent years, heterogeneous catalysts have gained much importance in organic synthesis due to eco-economic benefits. In connection with our work on the applications of heterogeneous catalysts for the development of useful synthetic methodologies we have discovered that PMA · SiO2 is highly effective to catalyze the Friedlander synthesis of quinolines in excellent yields. A variety of ketones afford the quinolines smoothly. The catalyst can be easily recovered and reused.

In conclusion, we have developed an efficient general route for the synthesis of quinolines via Friedlander annulation using PMA · SiO2 as a novel catalyst. The simple experimental procedure, mild reaction conditions, excellent yields, rapid conversion and recovery of the catalyst are the notable advantages of the present protocol. The catalyst is highly suitable for the preparation of diverse types of quinoline derivatives.

Experimental

To a mixture of 2-aminoaryl ketone (1 mmol) and α-methylene carbonyl compound (1.1 mmol) in EtOH (5 ml) PMA · SiO2 (10%, 100 mg) was added. The mixture was heated under reflux and the reaction was monitored TLC. After the completion the mixture was filtered and the catalyst was recovered. The filtrate was concentrated under vacuum and the residue was purified by column chromatography (silica gel, 5% EtOAc in hexane) to obtain pure quinoline derivative.

The recovered catalyst was used consecutively three times to afford the product without hampering its yield. As for an example, the reaction of 2-aminobenzophenone with ethyl acetacetate in the presence of the catalyst (PMA · SiO2) afforded the corresponding quinoline 3a, Table 1, entry a) in an yield of 88% while the same reaction using the recovered catalyst in consecutive three cycles furnished the products in the yields of 88, 87 and 87%.

The spectral (1H-NMR and MS) data of some representative quinolines are given below.

Product 3b (Table 1): 1H-NMR (200 MHz, CDCl3); δ 7.98 (2H, t, J = 8.0 Hz), 7.68 (1H, t, J = 8.0 Hz), 7.50 (1H, t, J = 8.0 Hz), 3.98 (3H, s), 2.65 (3H, s), 2.61 (3H, s), FAB-MS: m/z 236 [M+Na]+.

Product 3g (Table 1): 1H-NMR (200 MHz, CDCl3); δ 7.75 (1H, d, J = 8.0 Hz), 7.57 (1H, t, J = 8.0 Hz), 7.49 (1H, t, J = 8.0 Hz), 7.21 (1H, d, J = 8.0 Hz), 5.88 (2H, s), 1.97 (6H, s), 1.72 (3H, s), FAB-MS: m/z 236 [M+Na]+.

Product 3h (Table 1): 1H-NMR (200 MHz, CDCl3); δ 8.02 (1H, d, J = 8.0 Hz), 7.71 (1H, t, J = 8.0 Hz), 7.60—7.42 (5H, m), 7.40—7.29 (2H, m), 4.02 (2H, q, J = 7.0 Hz), 2.71 (3H, s), 0.94 (3H, t, J = 7.0 Hz), FAB-MS: m/z 314 [M+Na]+.

Product 3i (Table 1): 1H-NMR (200 MHz, CDCl3); δ 8.05 (1H, d, J = 8.0 Hz), 7.66—7.29 (8H, m), 3.22 (2H, t, J = 7.0 Hz), 2.90 (2H, t, J = 7.0 Hz), 1.71 (3H, s), FAB-MS: m/z 316 [M+Na]+.

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2.23—2.08 (2H, m); FAB-MS: m/z 268 [M+H]<sub>Na</sub>.

### Acknowledgements

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### References


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<sup>a</sup> The structures of the products were established from their spectral (1H-NMR and MS) data.  
<sup>b</sup> Isolated yield.

2.23—2.08 (2H, m); FAB-MS: m/z 268 [M+Na]<sup>+</sup>.