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Mesoporous Silica with Site-Isolated Amine and Phosphotungstic Acid Groups: A Solid Catalyst with Tunable Antagonistic Functions for One-Pot Tandem Reactions

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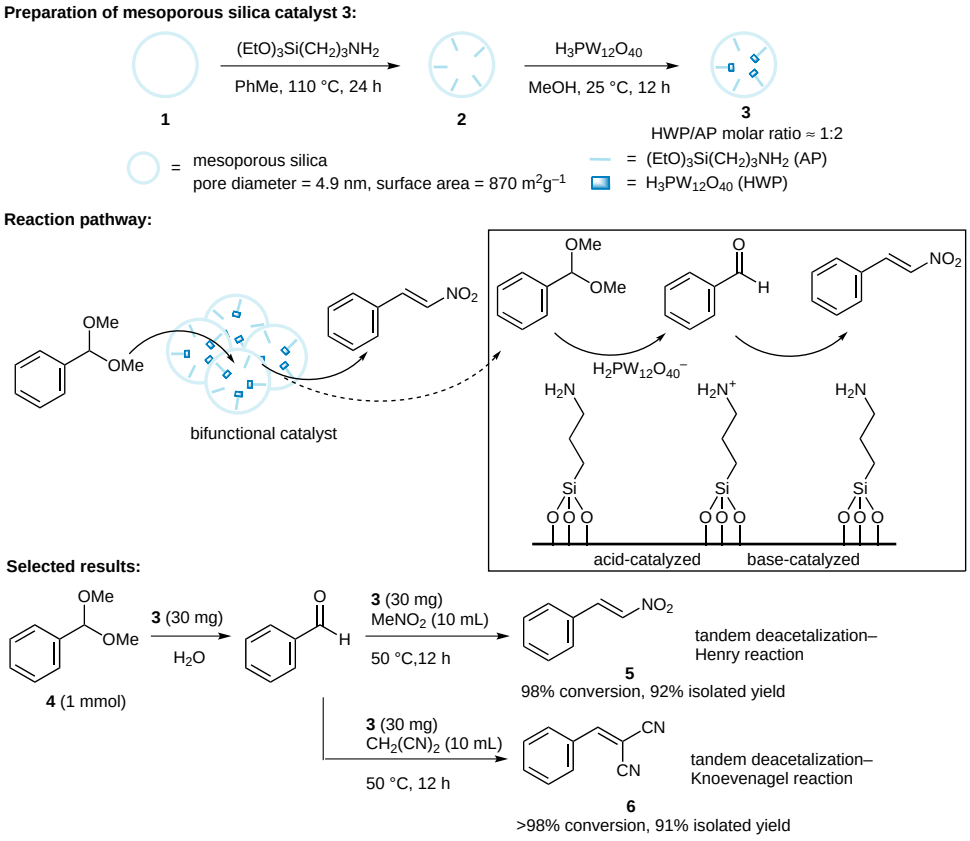
# One-Pot Tandem Reactions with a Bifunctional Solid Catalyst




**Significance:** A mesoporous silica catalyst **3** bearing both Brønsted base and acid groups was prepared by immobilization of 3-aminopropyltriethoxysilane [$(EtO)_3Si(CH_2)_3NH_2$] and phosphotungstic acid ($H_3PW_{12}O_{40}$) to a mesoporous silica. Catalyst **3** drove the tandem deacetalization–Henry reaction and deacetalization–Knoevenagel reaction of **4** with nitromethane and malononitrile to give *trans*-1-nitro-2-phenylethylene **5** and benzylidene malononitrile **6** in 92% and 91% yield, respectively.

**Comment:** The acid/base properties were controlled by the ratio and surface concentration of an amino group and phosphotungstate. Catalyst **3** was characterized by XANES (X-ray absorption near-edge structure spectrum), BET, BJH, $^{31}P$ NMR, $^{29}Si$ and $^{13}C$ CP-MAS NMR spectroscopy and GC-MS. Catalyst **3** was recovered by filtration and reused several times without significant loss of catalytic activity (4$^{th}$ use: **5** in 90% isolated yield, **6** in 91% isolated yield).

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**Category**

**Polymer-Supported Synthesis**

**Key words**

**bifunctional acid–base catalysis**

**one-pot synthesis**

**mesoporous silica**

**phosphotungstic acid**