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New Vanadium Keggin Heteropolyacids Encapsulated in a Silica Framework: Recyclable Catalysts for the Synthesis of Highly Substituted Hexahydropyrimidines Under Suitable Conditions

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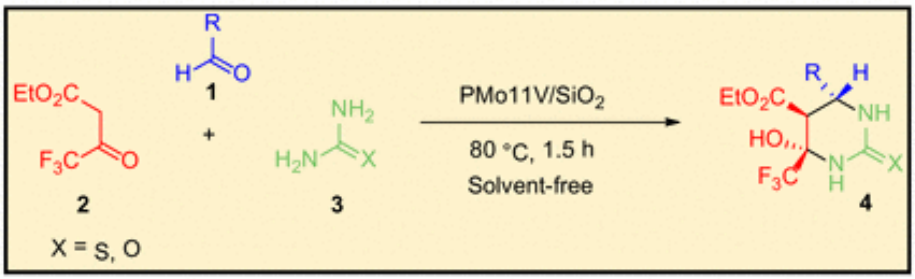
Abstract Solid acid catalysts based on the direct incorporation of the vanadium Keggin heteropolyacid (PMo11V) structure during the synthesis of silica by the sol–gel technique, in acidic media using tetraethyl orthosilicate ($PMo11VSiO_2$1, $PMo11VSiO_2$2, $PMo11VSiO_2$3, and $PMo11VSiO_2$4), were prepared and characterized by ^{31}P-NMR, FT-IR, XRD, and textural properties (S_{BET}). The acidic characteristics of the catalysts were determined by potentiometric titration with *n*-butylamine. A series of highly substituted hexahydropyrimidines were synthesized using these new materials, encapsulated in a silica framework, as catalyst in solvent-free conditions. This methodology requires short reaction time (1.5 h), a temperature of 80 °C in solvent free-conditions to obtain good to excellent yields of trifluoromethyl-hexahydropyrimidine derivatives. The Keggin catalyst embedded in the silica matrix is insoluble in polar media, which allows easy removal of the reaction products without affecting their catalytic activity. *Graphical Abstract*



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1 Introduction

The utilization of heterogeneous catalysts has gained much interest in recent decades due to economic and environmental considerations. These heterogeneous catalysts are more advantageous over homogeneous catalysts, mainly because they can be easily recovered from the reaction mixture by simple filtration procedures and then reused