Synthesis of smart bimetallic nano-Cu/Ag@SiO\textsubscript{2} for clean oxidation of alcohols

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ESI 1. Preparation of silica embedded Cu/Ag nanoparticles:

**Preparation of silica nanoparticles:** 5 gm TEOS in 10 ml ethanol was added drop wise over 30 minutes to 50 ml of ethanol-water mixture (1:1) containing 10 ml of 25% aq. NH₄OH at room temperature under vigorous stirring. Subsequently, the whole mixture was sonicated for 1 h and then aged over night at room temperature. The as prepared silica nanoparticles were then separated by simple filtration using whatman no. 1 filter paper and washed well with distilled H₂O followed by ethanol and then dried at 70°C for 6 h. Next, the silica nanoparticles were calcined at 550°C for 7 h.

**Preparation of silica embedded Cu/Ag nanoparticles:** Silica (1.0 gm) was dispersed in water (100 ml) under sonication, copper nitrate (152 mg) and silver nitrate (16 mg) were added to the aqueous suspension and stirred for 2h at room temperature. Sodium borohydride (250 mg) was added, in portion, with constant stirring at room temperature. The reaction mixture turns brown after NaBH₄ addition due to the formation of copper and silver nanoparticles. After 4 h stirring the nanoparticles were centrifuged, washed with acetone and dried under vacuum. The Cu/Ag@SiO₂ NPs were then characterized using XRD, SEM, HRTEM analysis.

ESI 2. FTIR spectra of fresh Cu/Ag@SiO₂ nanoparticles:

![FTIR spectra of fresh Cu/Ag@SiO₂ nanoparticles.](image)

**Fig. S1.** FTIR spectra of fresh Cu/Ag@SiO₂ nanoparticles.
ESI 3. General synthetic procedure for Cu/Ag@SiO₂ nanoparticles catalyzed oxidation of benzylic alcohols: Representative procedure for Cu/Ag@SiO₂ nanoparticles catalyzed oxidation of benzylalcohol: A 25 ml round bottomed flask equipped with a magnetic stirring bar, charged with benzylalcohol (1 mmol, 108.14), 70% aq. TBHP (2 equivalent, 180 mg), catalyst CuAg@SiO₂ NPs (20 mg) and 4 ml of toluene, heated at 120 °C for 4 h. The progress of the reaction was monitored by TLC. After the completion of the reaction, CuAg@SiO₂ NPs catalyst was separated using centrifuge and the product was isolated using ethyl acetate extraction and then purified by column chromatographic technique (isolated yield 99%, 105 mg).

All the prepared aldehydes/ketones were characterized by ¹H NMR spectroscopic studies. The spectroscopic data of all the prepared compounds were resembles with the reported data as all the compounds are reported in literature.

ESI 4. FTIR spectra of eight times reused Cu/Ag@SiO₂ NPs:

Fig. S2. FTIR spectra of eight times reused Cu/Ag@SiO₂ NPs.
ESI 5. $^1$H NMR spectra of prepared compounds:
1c, Table 2
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2g, Table 3
2m, Table 3
$\text{COCH}_3$

2p, Table 3