

## Supplementary Information

### Fly Ash Supported Pd-Ag Bimetallic Nanoparticles Exhibiting Synergistic Catalytic Effect for the Reduction of Nitrophenol

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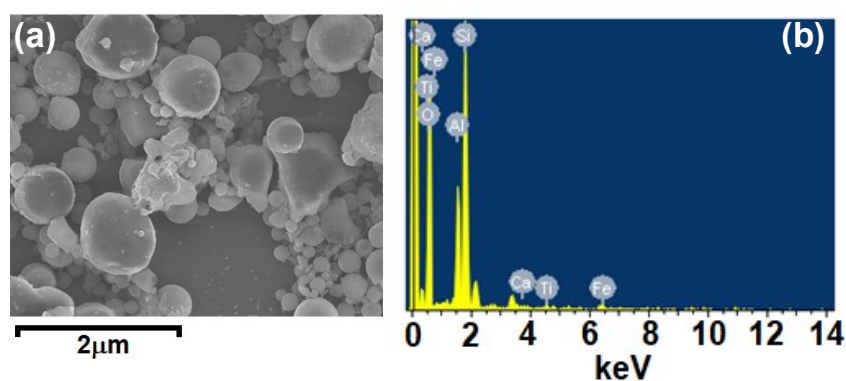
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**1. ICP-AES analysis data for fly ash supported metal nanoparticles**

**Table S1.**

Compound	Atomic Wt. (%)	
	Pd	Ag
FA-Pd-Ag	0.51	0.24
FA-Pd	0.93	0
FA-Ag	0	0.14

**2. SEM image and EDX spectrum of fly ash**



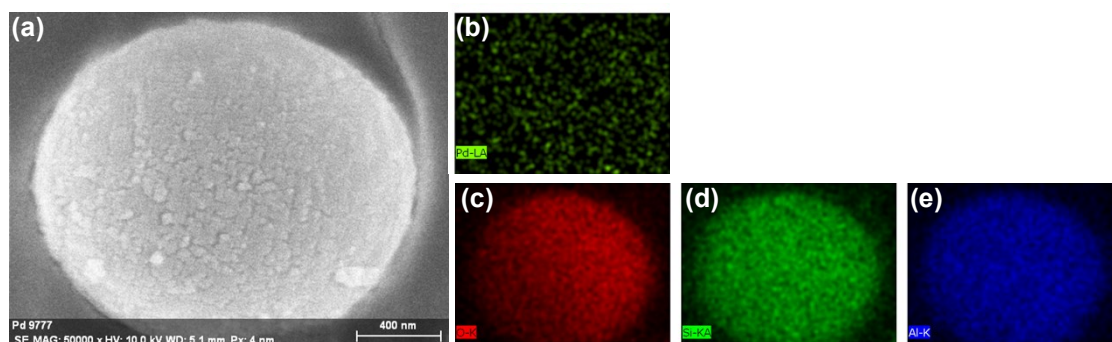
**Fig. S1** (a) SEM image and (b) EDX spectrum of fly ash.

**3. EDX data of fly ash**

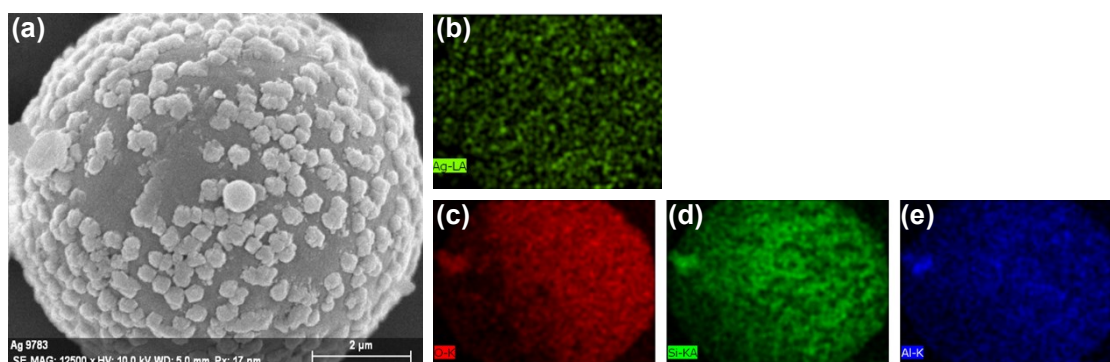
**Table S2.**

Compound	Atomic Wt. (%)					
	O	Si	Al	Ca	Ti	Fe
Fly ash (FA)	73-80	13-16	6-12	0.01-0.14	0.05-0.22	0.17-0.42

#### 4. FE-SEM images and elemental mapping for FA-Pd and FA-Ag

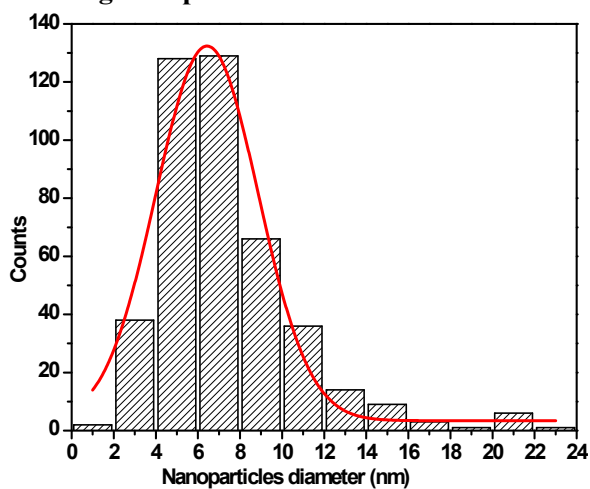


**Fig. S2** (a) FE-SEM image of FA-Pd. Elemental mapping showing the distribution of (b) Pd nanoparticles along with (c) O, (d) Si and (e) Al atoms on the surface of FA-Pd.



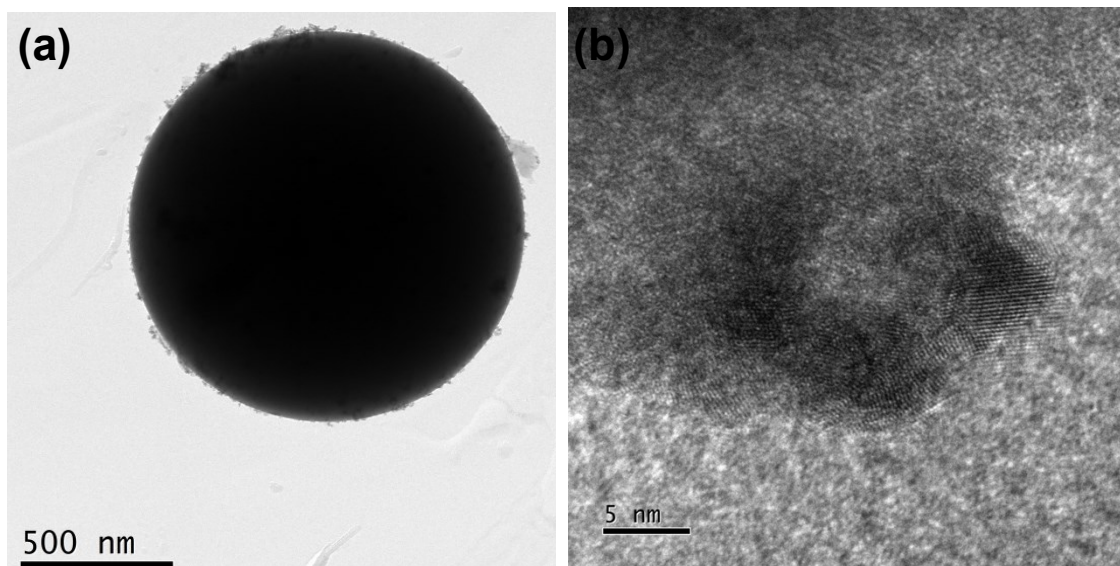
**Fig. S3** (a) FE-SEM image of FA-Ag. Elemental mapping showing the distribution of (b) Ag nanoparticles along with (c) O, (d) Si and (e) Al atoms on the surface of FA-Ag.

#### 5. Pd-Ag nanoparticles size distribution in FA-Pd-Ag

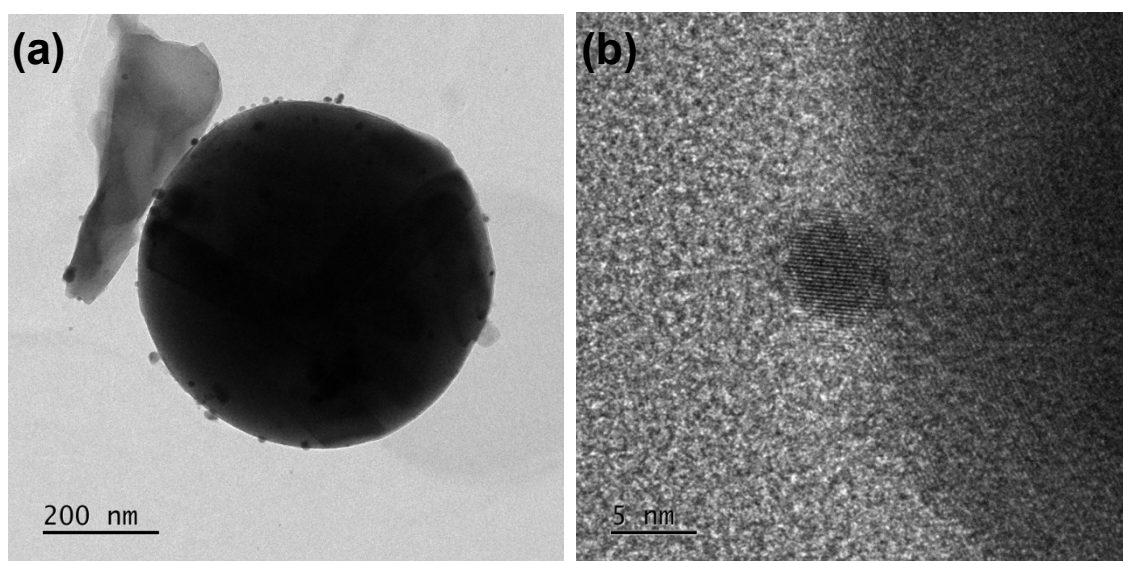


**Fig. S4** Size distribution histogram of Pd-Ag nanoparticles in FA-Pd-Ag.

## 6. TEM images for FA-Pd and FA-Ag



**Fig. S5** TEM image of (a) FA-Pd and (b) its expanded (HRTEM) view showing the lattice spacing of Pd nanoparticles.



**Fig. S6** TEM image of (a) FA-Ag and (b) its expanded (HRTEM) view showing the lattice spacing of Ag nanoparticles.

## 7. Pd and Ag nanoparticles size distribution in FA-Pd and FA-Ag

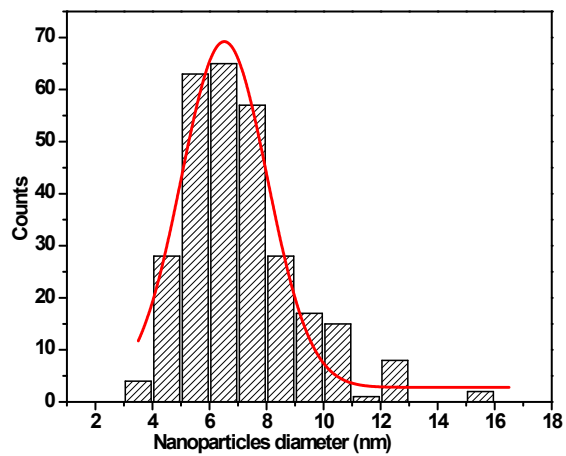


Fig. S7 Size distribution histogram of Pd nanoparticles in FA-Pd.

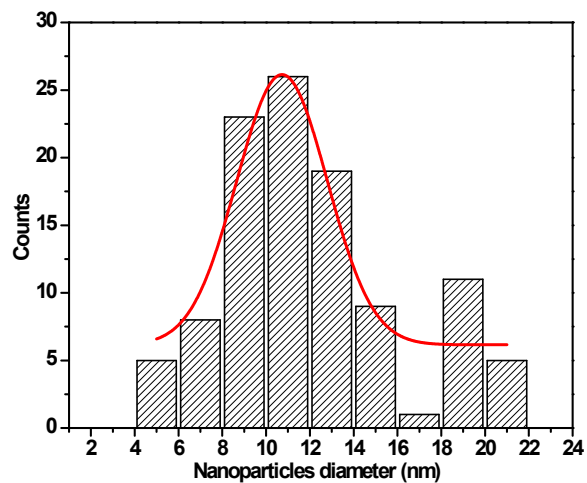


Fig. S8 Size distribution histogram of Ag nanoparticles in FA-Ag.

## 8. XPS survey spectrum

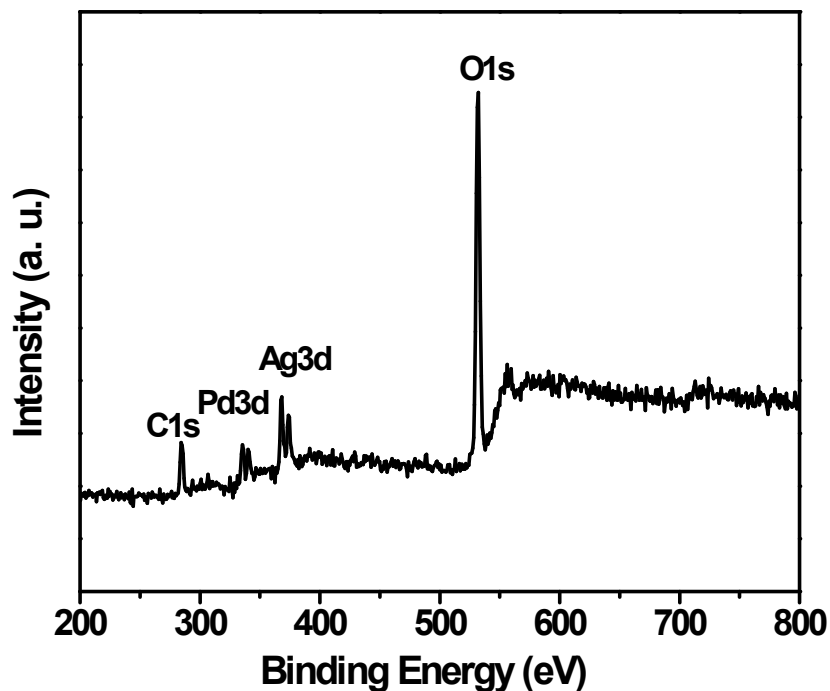


Fig. S9 XPS survey spectrum for FA-Pd-Ag.

## 9. UV-Vis spectra of reference compounds

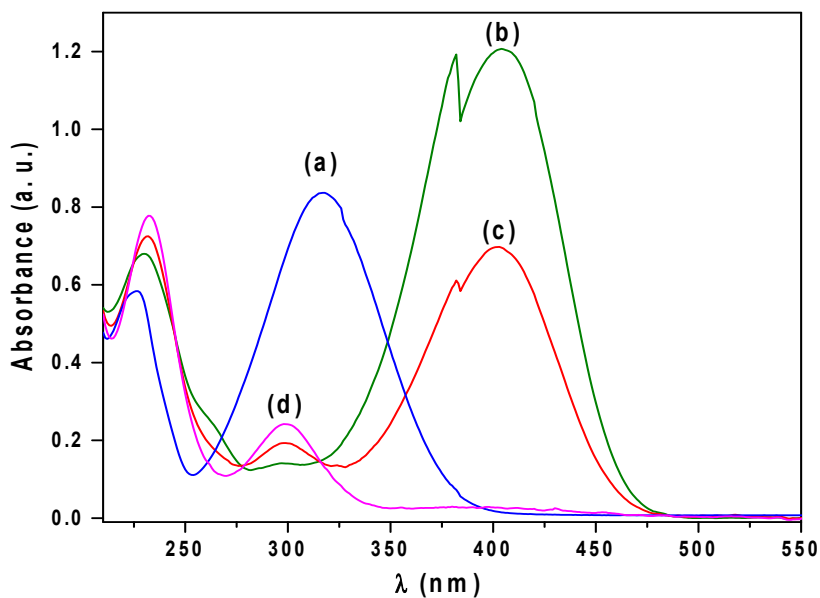
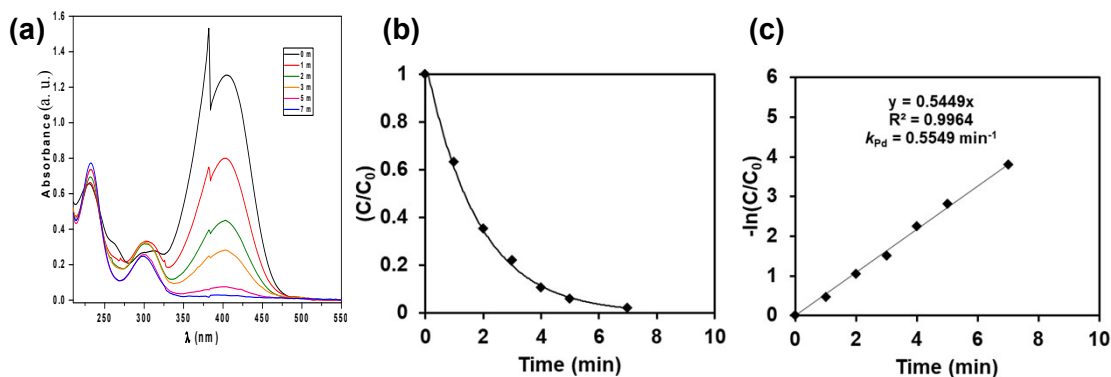
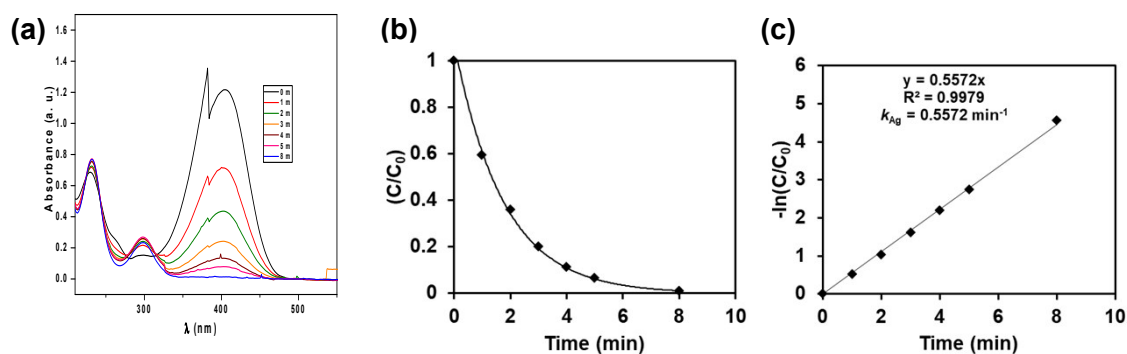


Fig. S10 UV-Vis Absorption spectra recorded for (a) 4-nitrophenol, (b) 4-nitrophenolate ion formed after the addition of  $\text{NaBH}_4$  into 4-nitrophenol solution, (c) 1 minute after the addition of CFA-Pd-Ag catalyst into the mixture of  $\text{NaBH}_4$  and 4-nitrophenol and (d) 4-aminophenolate ion.

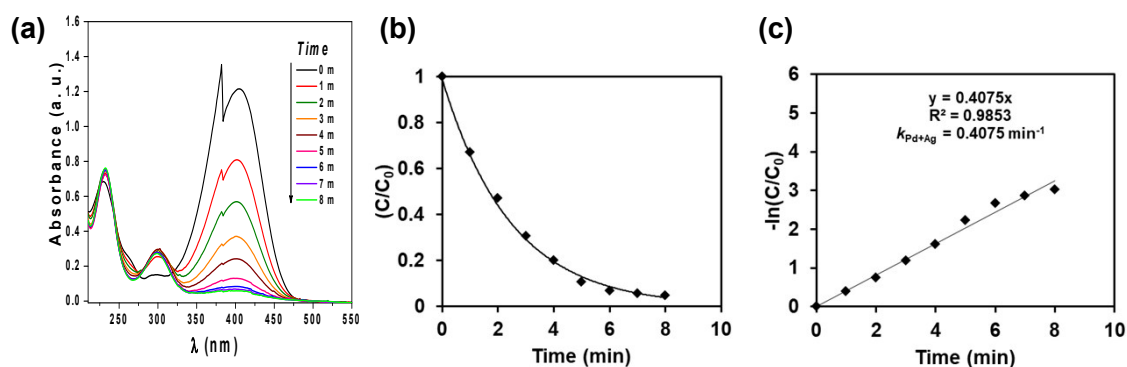
**10. Kinetic studies for the reaction of 4-nitrophenol by FA-Pd, FA-Ag, (FA-Pd+FA-Ag) and FA**



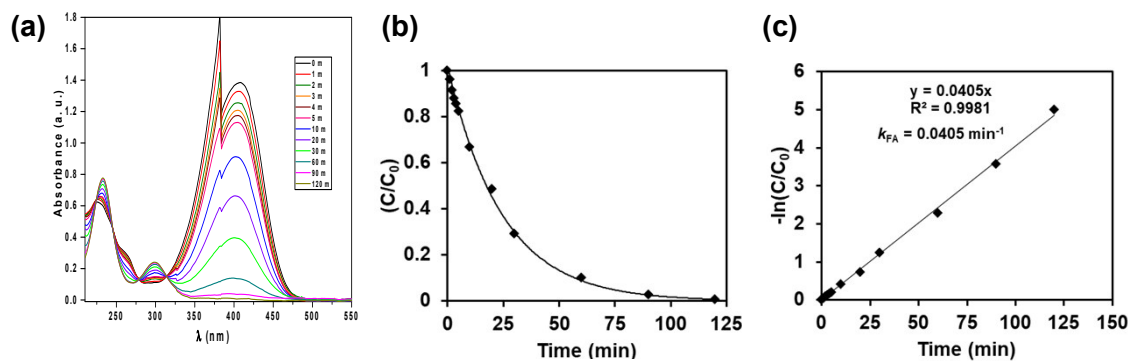
**Fig. S11** (a) Time-resolved UV-vis absorption spectra, (b)  $(C/C_0)$  vs time and (c)  $-\ln(C/C_0)$  vs time plots for the reduction of 4-nitrophenol utilizing FA-Pd.



**Fig. S12** (a) Time-resolved UV-vis absorption spectra, (b)  $(C/C_0)$  vs time and (c)  $-\ln(C/C_0)$  vs time plots for the reduction of 4-nitrophenol utilizing FA-Ag.



**Fig. S13** (a) Time-resolved UV-vis absorption spectra, (b)  $(C/C_0)$  vs time and (c)  $-\ln(C/C_0)$  vs time plots for the reduction of 4-nitrophenol utilizing (FA-Pd +FA-Ag).



**Fig. S14.** (a) Time-resolved UV–vis absorption spectra, (b)  $(C/C_0)$  vs time and (c)  $-\ln(C/C_0)$  vs time plots for the reduction of 4-nitrophenol utilizing FA.