Electronic Supplemntary Information

Facile and Green Cinchonidine-Assisted Synthesis of Ultrafine and Well-Dispersed Palladium Nanoparticles Supported on Activated Carbon with High Catalytic Performance

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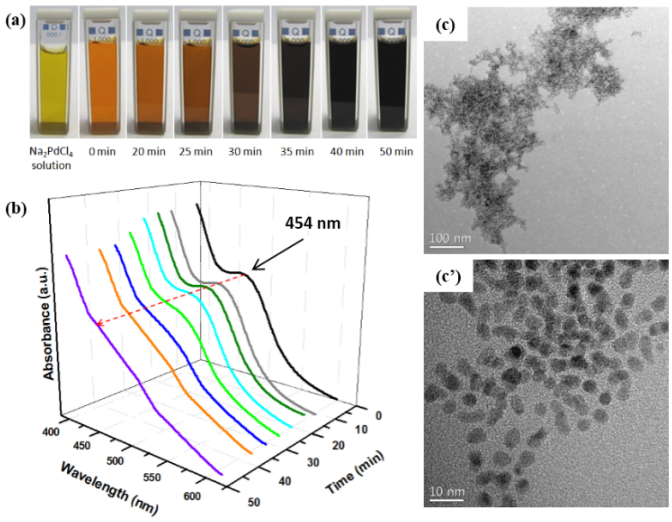

Fig. S1 (a) Digital photographs of the mixture containing Na_2PdCl_4, AA, and CD at various reaction times; (b) Time evolution of the UV-vis absorption spectra of the mixture; (c) and (c') TEM images of CD-stabilized Pd nanoparticles after 45 minutes at two different magnifications.

The colloidal Pd suspension was formed by the reduction of Na_2PdCl_4 with AA as a reducing agent in the presence of CD in an aqueous medium at room temperature. Immediately after adding the solution containing a mixture of AA and CD to the Na_2PdCl_4 solution, the color of the reaction mixture changed from light yellow to orange-red, as can be seen in **Fig. S1(a)**. In time, the reaction mixture gradually turned dark red and became absolutely black after 40 min, which indicates the formation of colloidal palladium. UV-vis absorption spectra of the aqueous mixture containing Na_2PdCl_4, AA, and CD recorded at various times are shown in **Fig. S1(b)**. The UV-vis spectra of the mixture at the first 15 minutes contain an absorption band at 454 nm, which is due to the d-d transition in the Pd^{2+} precursor.[1] This absorption band gradually broadens after 20 min and disappears completely after 40 min, indicating the completion of the reduction of Pd^{2+} ions to Pd^0 nanoparticles,[2] and is consistent with the color changes in the digital photographs. The TEM images in **Figs. S1(c)** and **S1(c')** of the CD-stabilized Pd nanoparticles after 45 min of reaction

show monodisperse and uniform Pd nanoparticles with a tendency to agglomerate. The typical size of these Pd nanoparticles is less than 10 nm.

References

1. M. Rakap, *Appl. Catal. B*, 2015, **163**, 129-134.
2. M. N. Nadagouda and R. S. Varma, *Green Chemistry*, 2008, **10**, 859-862.

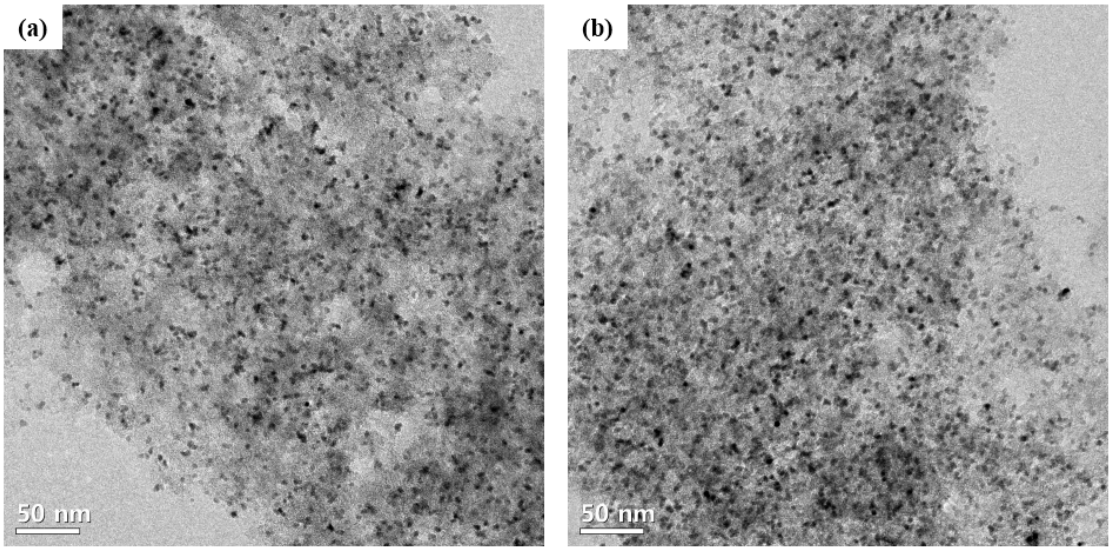

Fig. S2 TEM images of the samples (a) Pd/AC(no wash) and (b) Pd/AC(wash).

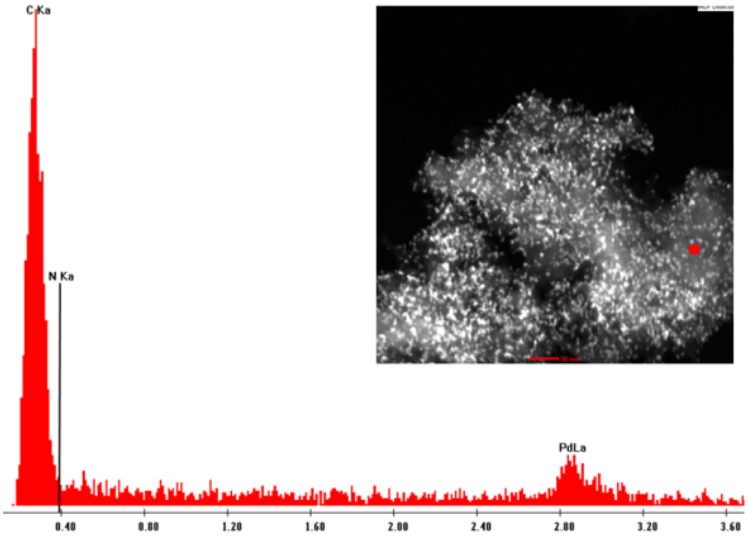

Fig. S3 EDS spectrum of the area marked as a small red spot in the corresponding dark-field image of the sample Pd/AC(wash).

Table S1. C,N,H elemental analysis results.

Elements (%)	**N**	**C**	**H**
Pd/AC(no wash)	2.48	76.28	1.19
Pd/AC(wash)	0.45	76.61	1.36

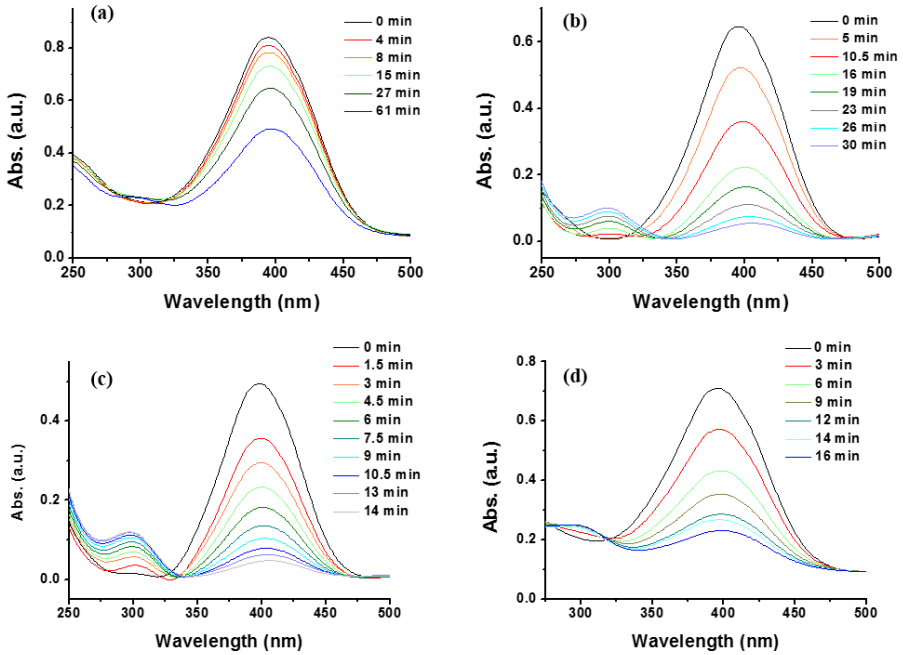

Fig. S4 UV-vis spectra of the reduction of 4-nitrophenol in aqueous solution with the catalysts (a) Pd/AC-noCD, (b) Pd/AC(no wash), (c) Pd/AC-1, and (d) Pd/AC-2.

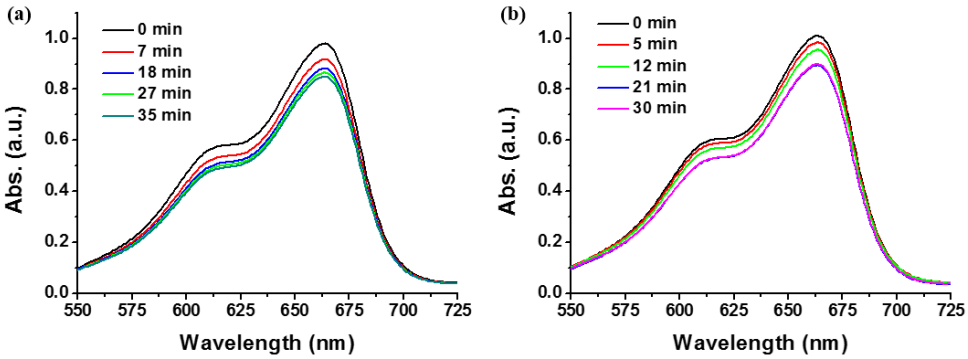

Fig. S5 Absorption spectra of the reduction of MB in aqueous solution in the presence of (a) AC and (b) no catalyst.

Table S2. The amount of Pd loading of the Pd/AC(wash) catalyst before and after 5 recycling runs, as determined by the ICP analysis.

	Before recyclability	After recyclability	
		4-nitrophenol	MB
Pd loading (wt%)	4.83	4.81	4.79