Appendix A. Supplementary data

Enhanced Catalytic Benzene Oxidation over a Novel Waste-derived Ag/Eggshell Catalyst

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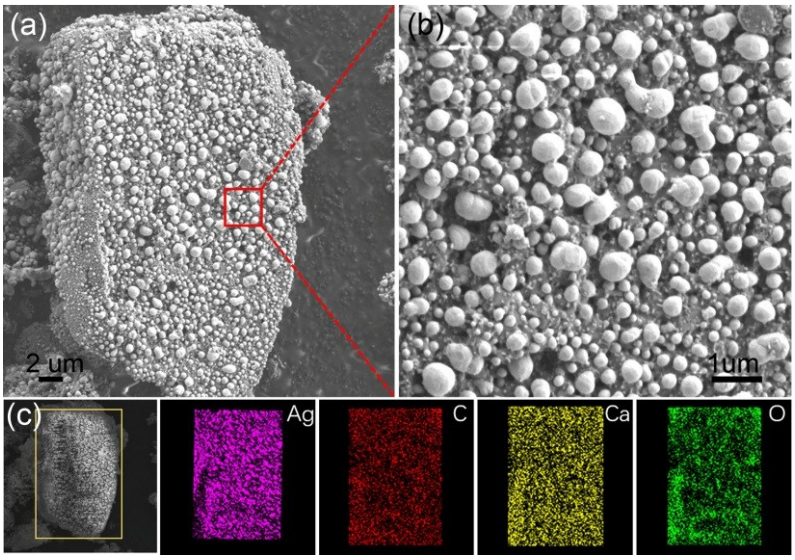

Fig. S1 (a-b) SEM images of Ag_2/Eggshell and the corresponding EDX elemental mapping images of Ag, C, Ca and O.

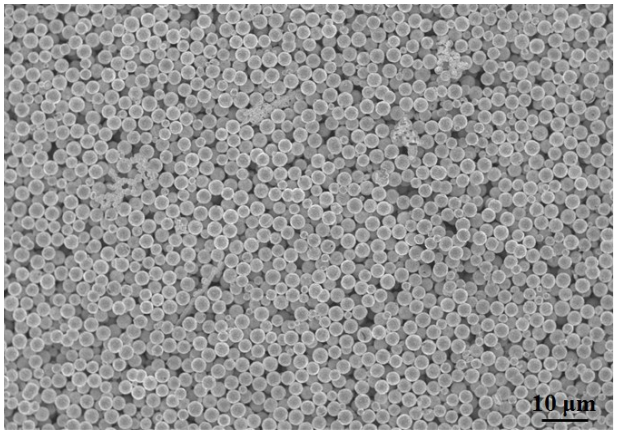

Fig. S2 SEM image of the pure Ag NPs.

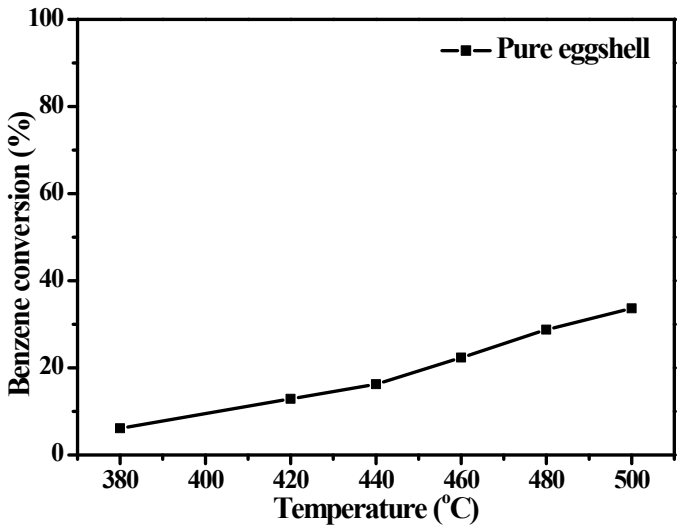

Fig. S3 Benzene conversion as a function of reaction temperature over pure eggshell at SV=20,000 mL/g/h.

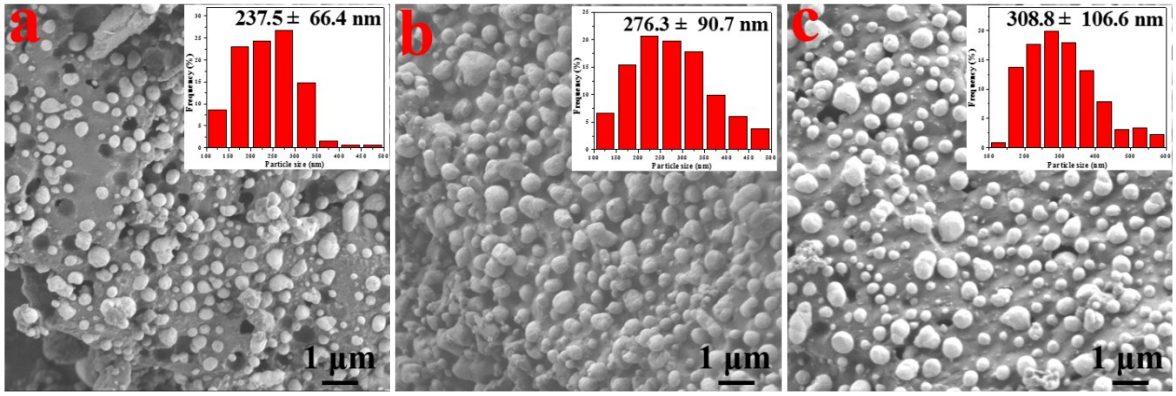

Fig. S4 SEM images and the corresponding histograms of Ag NPs distribution (insets) of xAg/Eggshell with different Ag loadings: (a) Ag_1/Eggshell, (b) Ag_2/Eggshell and (c) Ag_3/Eggshell.

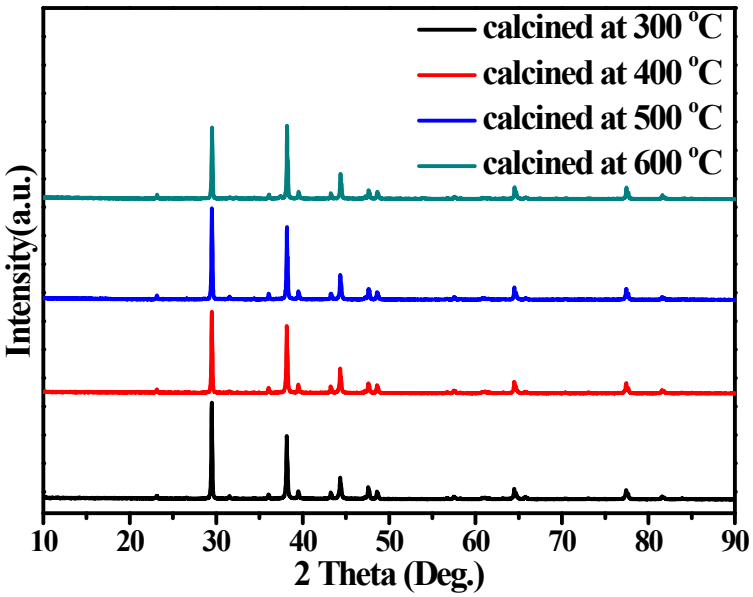

Fig. S5 XRD patterns of Ag_2/Eggshell with different calcined temperatures.

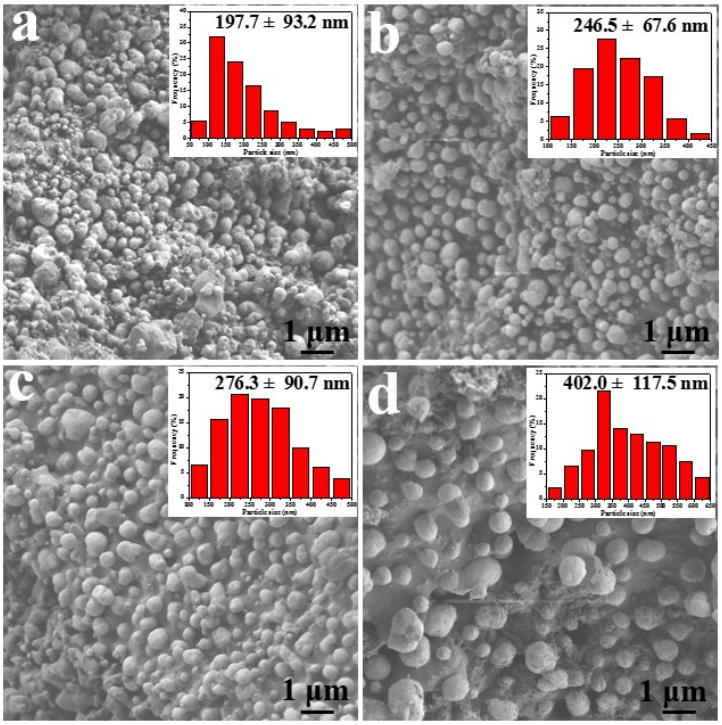

Fig. S6 SEM images and the corresponding histograms of Ag NPs distribution (insets) of Ag_2/Eggshell with different calcined temperatures: (a) 300, (b) 400, (c) 500 and (d) 600 °C.

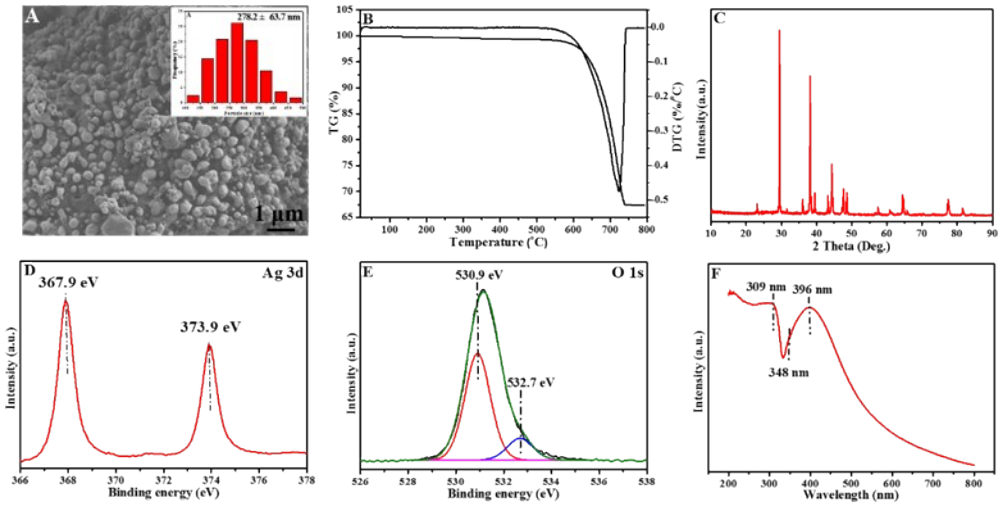

Fig. S7 (A) SEM image (insert: the histogram of Ag NPs distribution), (B) TG/DTG profile, (C) XRD pattern, (D) Ag 3d XPS spectrum and (E) O 1s XPS spectrum (F) UV-vis DRS spectra of the Ag_2/Eggshell after reaction of 200 h at 230 °C.

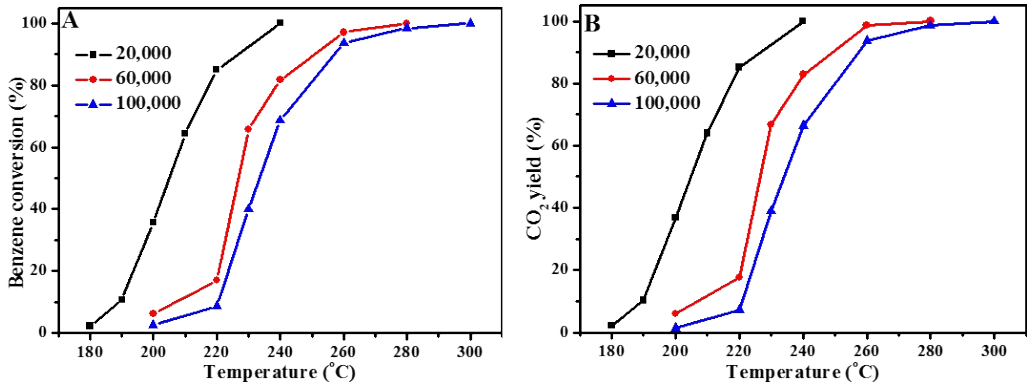

Fig. S8 Effects of different SV onto the catalytic activity of the Ag_2/Eggshell catalyst, (A) the relationship between benzene conversion and temperatures (B) the relationship between CO_2 yield and temperatures.

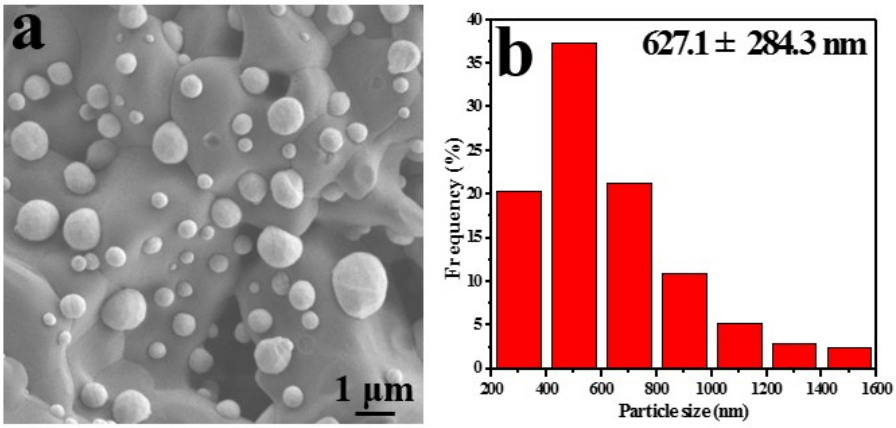

Fig. S9 (a) SEM image and (b) the corresponding histogram of size distribution of Ag NPs of Ag_2/com-$CaCO_3$ catalyst.

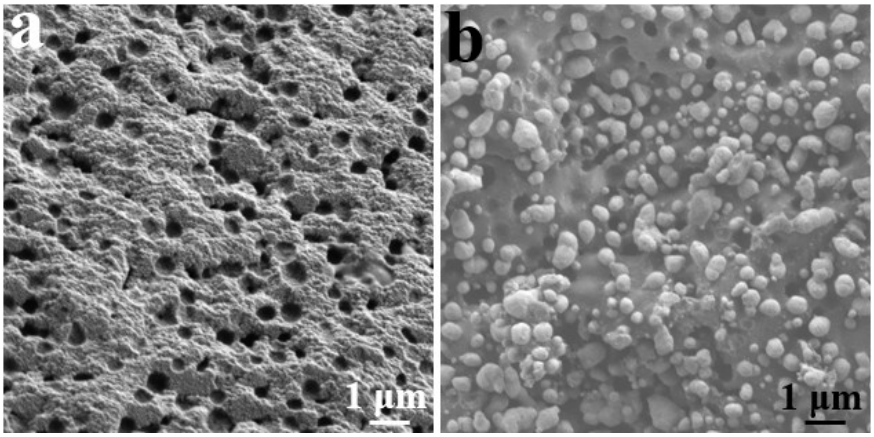

Fig. S10 SEM images of (a) pure eggshell and (b) Ag_2/Eggshell catalyst.

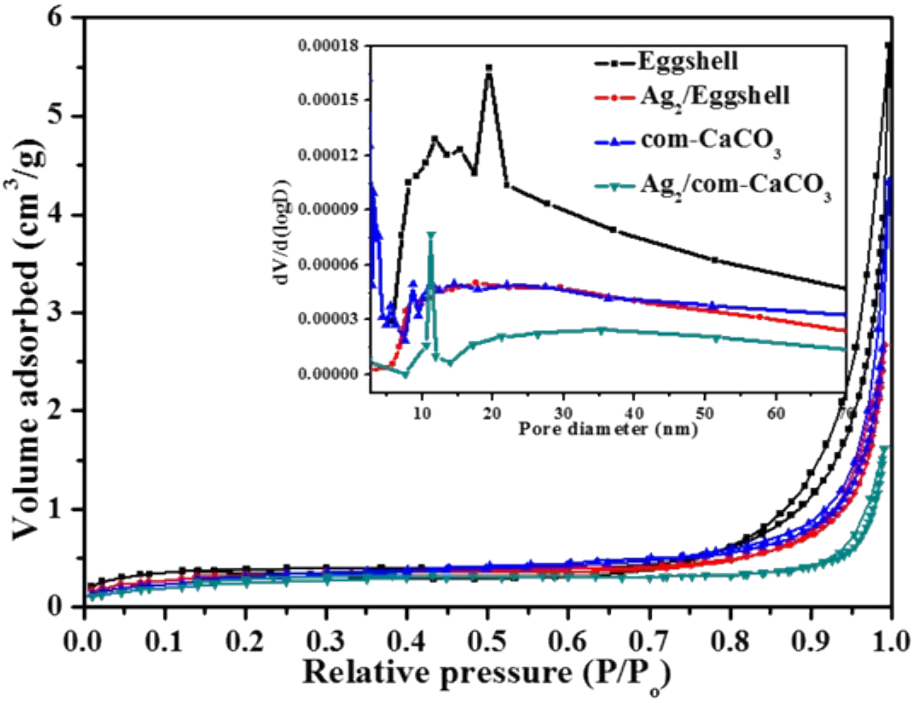

Fig. S11. Nitrogen adsorption-desorption isotherm and the corresponding pore size distribution curves (inlet) of various supports and Ag catalysts.

Table S1. Textural properties of various supports and Ag catalysts.

Sample	BET surface area (m^2/g)	Pore volume[a] (cm^3/g)
Eggshell	<5	0.008
Ag_2/Eggshell	<5	0.004
com-$CaCO_3$	<5	0.006
Ag_2/com-$CaCO_3$	<5	0.003

[a] Calculated from the volume adsorbed at P/P0 = 0.99. [b] Calculated from the desorption branch of nitrogen isotherm by using the BJH model.

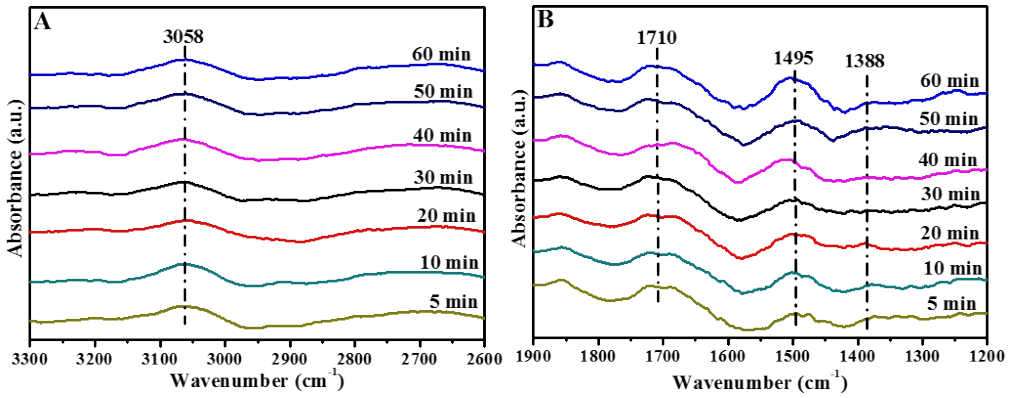

Fig. S12 *In situ* FTIR spectra reacted in 1000 ppm benzene/N_2 stream at 260 °C over Ag_2/Eggshell at different times.

Table S2 Catalytic performance comparison of various catalysts on benzene oxidation reported in the literature.

Catalyst	Preparation method	Concentration (ppm)	Space velocity	$T_{90\%}$ (°C)	Ref.
1.0Pt/CeO_2/Al_2O_3	Wet impregnation	1000	8,400 mL/g/h	245	1
5Ag/ZrO_2	Impregnation	395	120,000 mL/g/h	315	2
0.2Pd-Ni/SBA-15	Co-impregnation	1000	120,000 mL/g/h	258	3
2.0Au/p-SnO_2	Deposition-precipitation	2000	18,000 mL/g/h	367	4
0.8Pd/Ceramic-S	Impregnation	1500	90,000 mL/g/h	225	5
0.2Pd/La-ZSM-5-OM	Chemical impregnation	1000	20,000 h^{-1}	250	6
Ag_2/Eggshell	Impregnation	1000	20,000 mL/g/h	225	This work

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