Supplementary Data

For

New Multicomponent CDs/Ag@Mg-Al-Ce-LDH Nanocatalyst for Highly Efficient Degradation of Organic Water Pollutants

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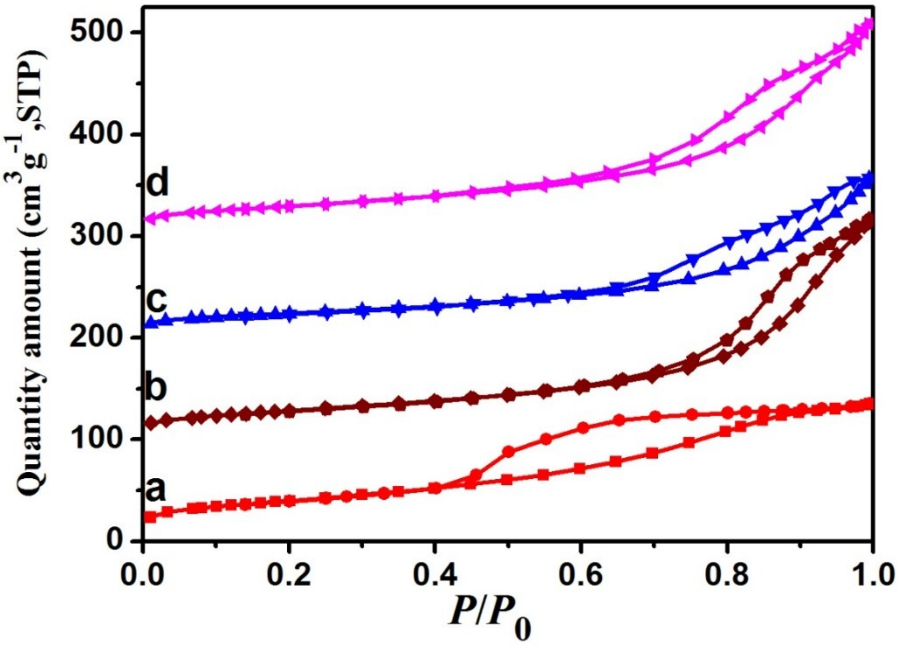

Fig. S1 N_2 adsorption/desorption isotherms of (a) Mg-Al-Ce-LDH, (b) CDs@Mg-Al-Ce-LDH, (c) Ag@Mg-Al-Ce-LDH, and (d) CDs/Ag@Mg-Al-Ce-LDH.

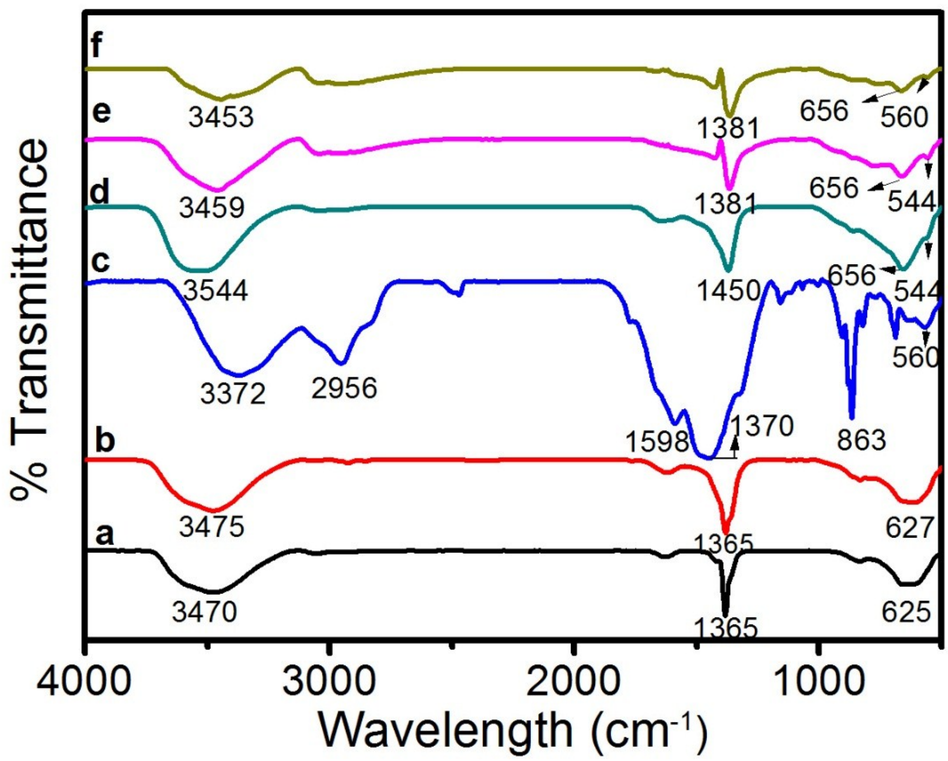

Fig. S2 FT-IR spectra of Mg-Al-LDH (a), Mg-Al-Ce-LDH (b), CDs (c), CDs@Mg-Al-Ce-LDH (d), Ag@Mg-Al-Ce-LDH (e), and CDs/Ag@Mg-Al-Ce-LDH (f).

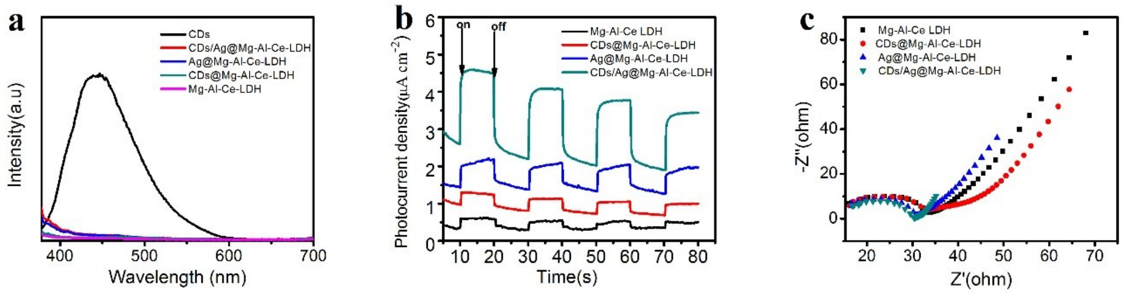

Fig. S3 Photoluminescence spectra (a), transient photocurrent responses (b), and EIS Nyquist plots (c) of Mg-Al-Ce-LDH, CDs@Mg-Al-Ce-LDH, Ag@Mg-Al-Ce-LDH, and CDs/Ag@Mg-Al-Ce-LDH.

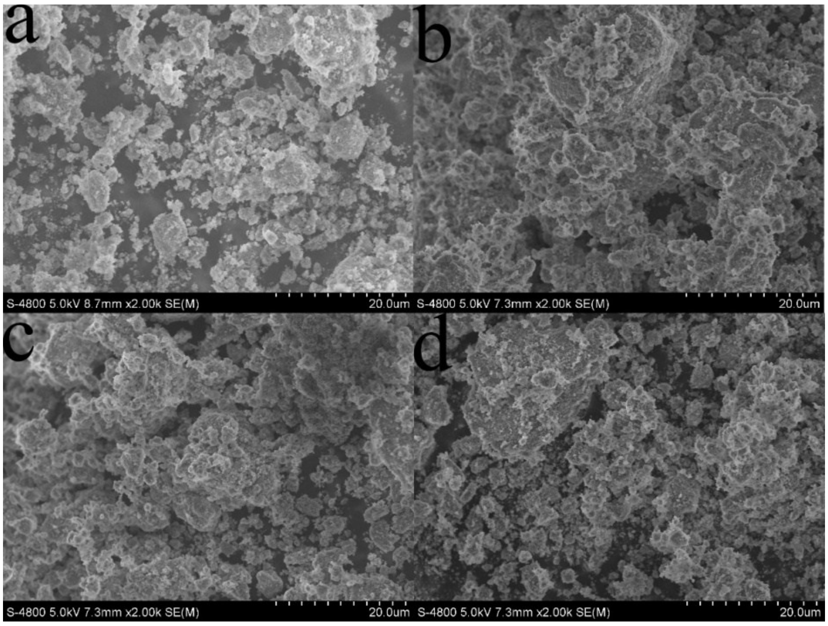

Fig. S4 SEM images of Mg-Al-Ce-LDH (a), CDs@Mg-Al-Ce-LDH (b), Ag@Mg-Al-Ce-LDH (c), and CDs/Ag@Mg-Al-Ce-LDH (d).

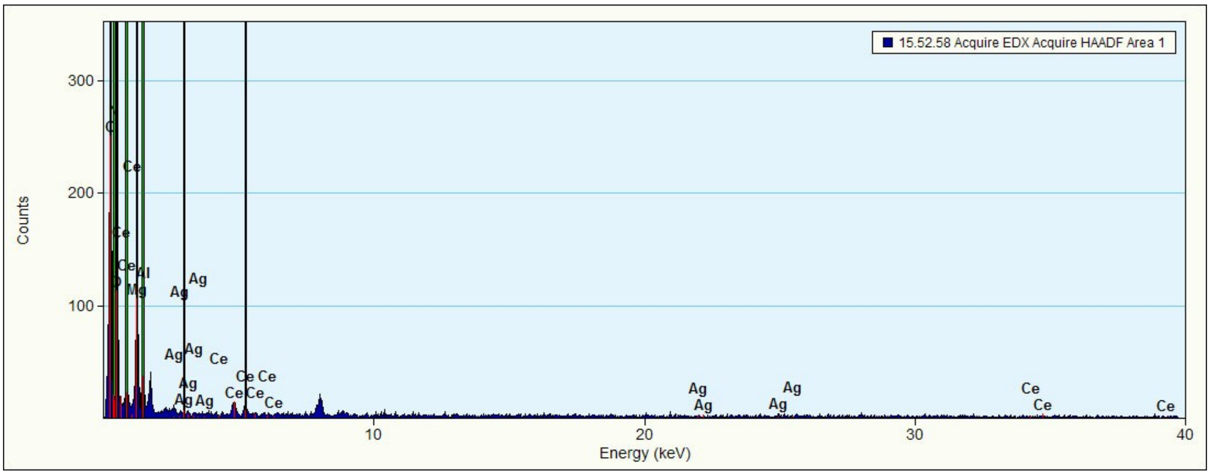

Fig. S5 EDX spectrum of CDs/Ag@Mg-Al-Ce-LDH. The Cu signals originate from Cu grid.

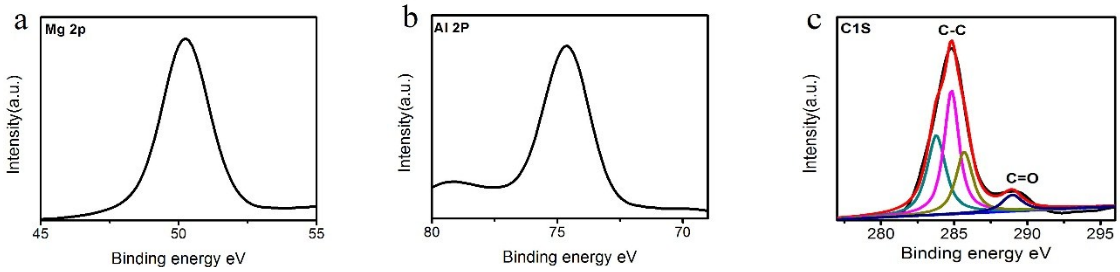

Fig. S6 High-resolution XPS spectra of CDs/Ag@Mg-Al-Ce-LDH: Mg 2p (a), Al 2p (b), and C 1s (c).

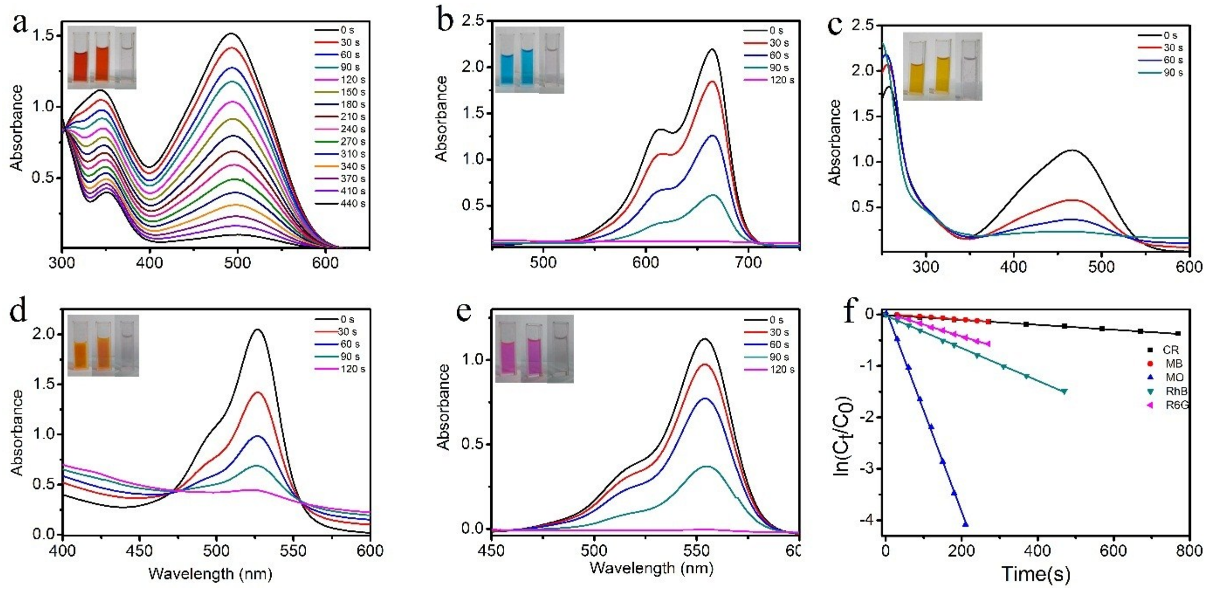

Fig. S7 Time-dependent UV-vis absorption spectra and photographs for the reduction of reaction mixtures containing (a) CR, (b) MB, (c) MO, (d) R6G, and (e) RhB. (f) Calibration curves as a function of ln(C_t/C_0) *vs.* reaction time in aqueous solutions with $NaBH_4$ in the presence of CDs/Ag@Mg-Al-Ce-LDH as a catalyst. Conditions: CDs/Ag@Mg-Al-Ce-LDH (20 μL, 1 mg/mL), 2.5 mL aqueous solutions of (a) CR (6.0×10^{-5} M), (b) MB (3.0×10^{-5} M), (c) MO (1.0×10^{-4} M), (d) R6G (4.0×10^{-4} M), (e) RhB (2.0×10^{-6} M), and $NaBH_4$ (0.01 M, 480 μL).

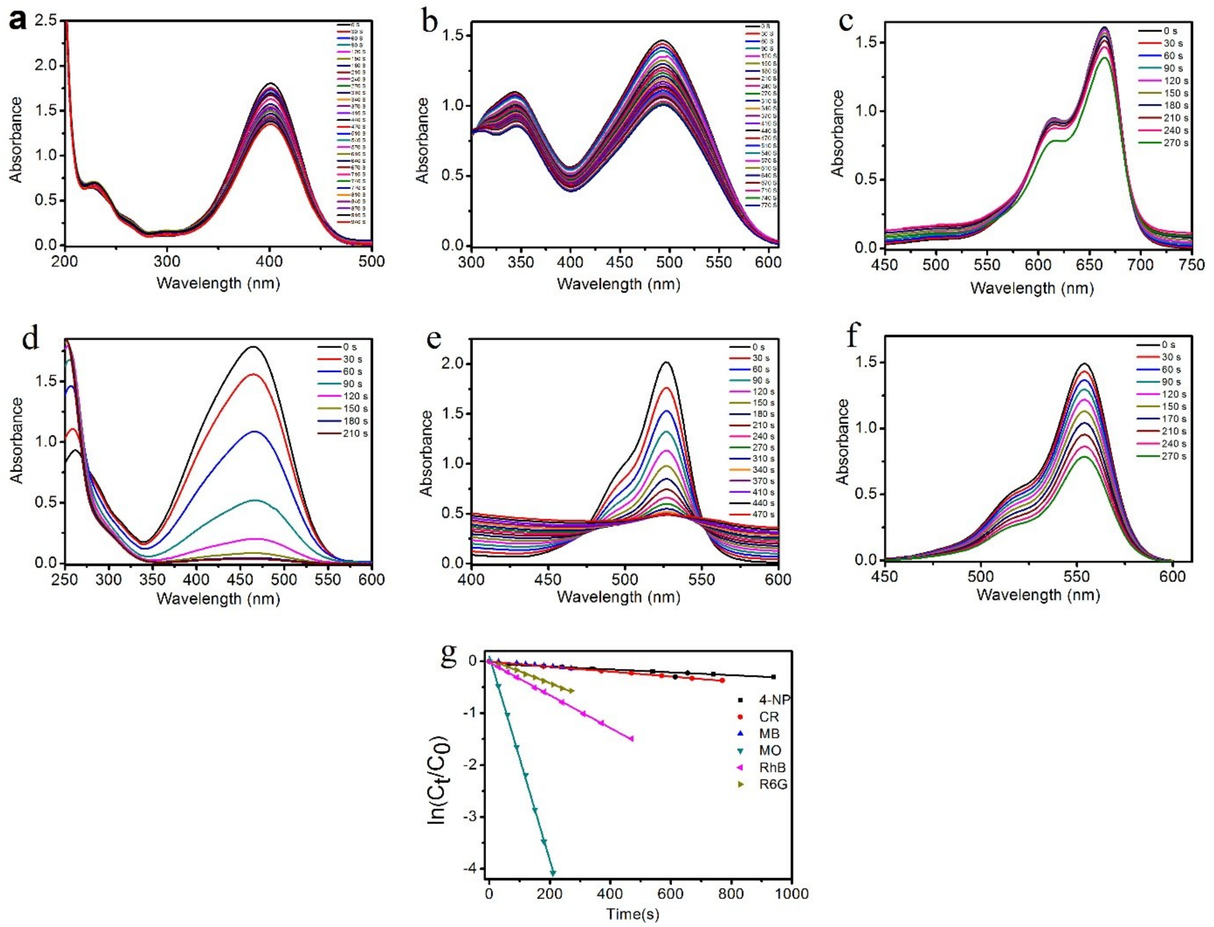

Fig. S8 Time-dependent UV-vis absorption spectra for the reduction of reaction mixtures containing (a) 4-NP (b) CR, (c) MB, (d) MO, (e) R6G, and (f) RhB. (g) Calibration curves as a function of ln(C_t/C_0) *vs.* reaction time in aqueous solutions with $NaBH_4$ in the presence of Ag@Mg-Al-Ce-LDH as a catalyst. Conditions: Ag@Mg-Al-Ce-LDH (20 µL, 1 mg/mL), 2.5 mL aqueous solutions of (a) 4-NP (0.01 M) (b) CR (6.0×10^{-5} M), (c) MB (3.0×10^{-5} M), (d) MO (1.0×10^{-4} M), (e) R6G (4.0×10^{-4} M), (f) RhB (2.0×10^{-6} M), and $NaBH_4$ (0.01 M, 480 µL).

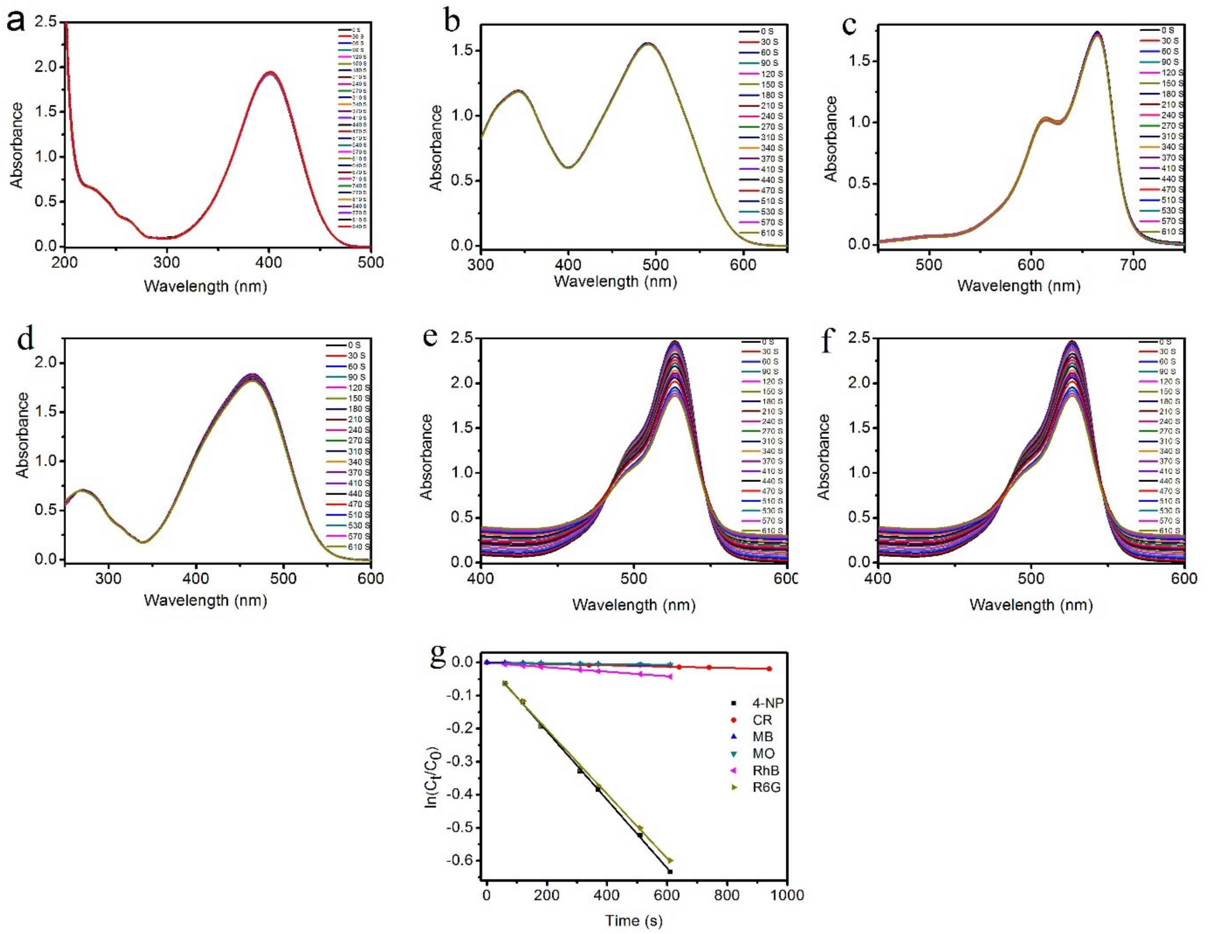

Fig. S9 Time-dependent UV-vis absorption spectra for the reduction of reaction mixtures containing a) 4-NP (b) CR, (c) MB, (d) MO, (e) R6G, and (f) RhB. (g) Calibration curves as a function of ln(C_t/C_0) *vs.* reaction time in aqueous solutions with $NaBH_4$ in the presence of CDs@Mg-Al-Ce-LDH as a catalyst. Conditions: CDs@Mg-Al-Ce-LDH (20 µL, 1 mg/mL), 2.5 mL aqueous solutions of (a) 4-NP (0.01 M) (b) CR (6.0×10^{-5} M), (c) MB (3.0×10^{-5} M), (d) MO (1.0×10^{-4} M), (e) R6G (4.0×10^{-4} M), (f) RhB (2.0×10^{-6} M), and $NaBH_4$ (0.01 M, 200 µL for 4-NP and 480 µL for dyes).

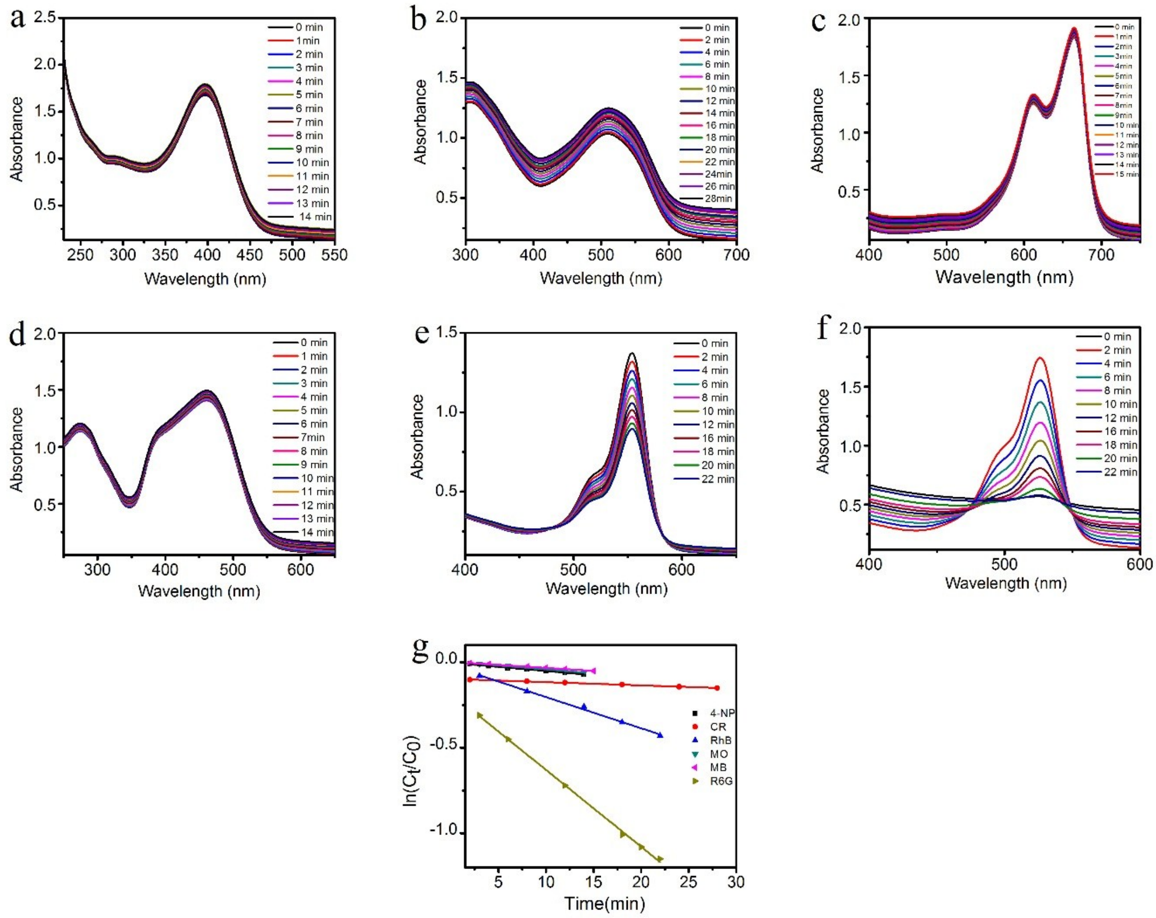

Fig. S10 Time-dependent UV-vis absorption spectra for the reduction of reaction mixtures containing (a) 4-NP, (b) CR, (c) RhB, (d) MO, (e) MB, and (f) R6G. (g) Calibration curves as a function of ln(C_t/C_0) *vs.* reaction time in aqueous solutions with $NaBH_4$ in the presence of Mg-Al-Ce-LDH as a catalyst. Conditions: Mg-Al-Ce-LDH (20 μL, 1 mg/mL), 2.5 mL aqueous solutions of (a) 4-NP (0.01 M) (b) CR (6.0×10^{-5} M), (c) RhB (2.0×10^{-6} M), (d) MO (1.0×10^{-4} M), (e) MB (3.0×10^{-5} M), (f) R6G (4.0×10^{-4} M), and $NaBH_4$ (0.01 M, 200 μL for 4-NP and 480 μL for dyes).

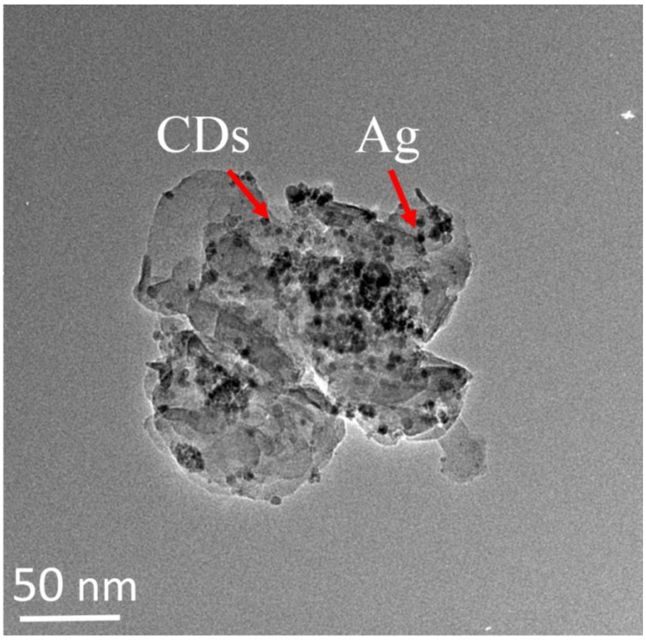

Fig. S11 TEM image of recovered CDs/Ag@Mg-Al-Ce-LDH after catalytic reaction.

Table S1 Textural properties of the as-synthesized catalysts.

Catalyst	Surface area (m^2/g)	Total pore volume (cm^3/g)
CDs/Ag@MgAlCe-LDH	148.7	0.56
CDs@MgAlCe-LDH	84.5	0.32
Ag@MgAlCe-LDH	106.7	0.24
MgAlCe-LDH	57.2	0.19

Table S2 Comparison of various catalytic systems for the reductive degradation of 4-NP.

Catalyst	**Support**	**Reaction time (s)**	k_{app} **(S^{-1})**	**TOF (h^{-1})**	**Reference**
Fe_3O_4/Ag/@NFC	NFC	1440	3.3×10^{-3}	157	S1
Ag NPs/SNTs-4	SNTs	90	3.8×10^{-2}	48	S2
CNFs/Ag NPs	CNFs	2808	4.6×10^{-3}	35	S3
Ag@Pd/Fe_3O_4	Magneitite MNPs	120	3.3×10^{-2}	27	S4
Ag/C	Pluronic F127	1800	5.3×10^{-3}	22	S5
Ag/Iron oxide	L-argininel	2408	2.4×10^{-3}	13	S6
Ag-Au nanowire	PAMAM	1800	3.8×10^{-3}	1.4	S7
Ni/SNTs	SiO_2@CeO_2	300	8.4×10^{-1}	1.9	S8
Micelle-supported Ag NPs	PNIPAP-b-P4VP	1950	1.5×10^{-3}	16	S9
Au-DEND550-1	Au-DEND-PEG550	350	9.4×10^{-3}	901	S10
Ag@Mg-Al-Ce-LDH	**Mg-Al-Ce-LDH**	**940**	$\mathbf{2.1 \times 10^{-2}}$	$\mathbf{7.6\times 10^{6}}$	**This work**
CDs/Ag@Mg-Al-Ce-LDH	**Mg-Al-Ce-LDH**	**120**	$\mathbf{3.8 \times 10^{-2}}$	$\mathbf{6.0 \times 10^{7}}$	**This work**

Table S3 Comparison of various catalytic systems for the reductive degradation of dyes: methylene blue (MB), methyl orange (MO), Congo red (CR), rhodamine B (RhB), and rhodamine 6G (R6G).

Catalyst	**Support**	**Dye**	**Dye concentration**	**Reaction time (s)**	**k_{app} (s^{-1})**	**TOF (h^{-1})**	**Reference**
AgNP-biophytum	biophytum	MB	0.08×10^{-3} M	360	2.1×10^{-2}	0	S11
Au@TA-GH	Graphene	MB	0.63 μM	540	2.0×10^{-3}	26	S12
Au NPs	P.benghalensis	MB	10 mg mL^{-1}	480	2.9×10^{-3}	-	S13
Au/$KNbO_3$	$KNbO_3$	MB	4.0×10^{-5} M	7200	2.0×10^{-4}	0.05	S14
Au NPs	S.acuminatafruit extract	MB	10^{-4} N	720	7.0×10^{-4}	0	S15
Au NPs	Kashayam	MB	9.4×10^{-5} M	300	5.5×10^{-3}	0	S16
CDs/Ag@Mg-Al-Ce-LDH	**Mg-Al-Ce-LDH**	**MB**	**3.0×10^{-5} M**	**120**	**2.3×10^{-2}**	**1.4×10^{5}**	**This work**
Fe_3O_4@C16@CTS-Au NPs(G)	Fe_3O_4	MO	1.0×10^{-4} M	120	2.0×10^{-2}	304	S17
AgNP-biophytum	biophytum	MO	0.01×10^{-2} M	540	4.5×10^{-3}	0	S11
Au NPs	S.acuminata fruit extract	MO	10^{-4} N	720	6.0×10^{-4}	0	S15
CDs/Ag@Mg-Al-Ce-LDH	**Mg-Al-Ce-LDH**	**MO**	**1.0×10^{-4} M**	**120**	**3.2×10^{-2}**	**4.6×10^{5}**	**This work**
Fe_3O_4@C16@CTS-Au NPs(G)	Fe_3O_4	CR	6.0×10^{-5} M	150	1.3×10^{-2}	149	S17
CDs/Ag@Mg-Al-Ce-LDH	**Mg-Al-Ce-LDH**	**CR**	**6.0×10^{-5} M**	**440**	**2.4×10^{-2}**	**7.6×10^{4}**	**This work**
Fe_3O_4@C16@CTS-Au NPs(G)	Fe_3O_4	RhB	2.0×10^{-6} M	140	1.6×10^{-2}	4.8	S17
CDs/Ag@Mg-Al-Ce-LDH	**Mg-Al-Ce-LDH**	**RhB**	**2.0×10^{-6} M**	**120**	**4.5×10^{-2}**	**9.3×10^{3}**	**This work**
Fe_3O_4@C16@CTS-Au NPs(G)	Fe_3O_4	R6G	4.0×10^{-4} M	240	1.0×10^{-2}	626	S17
CDs/Ag@Mg-Al-Ce-LDH	**Mg-Al-Ce-LDH**	**R6G**	**4.0×10^{-4} M**	**90**	**5.5×10^{-2}**	**1.8×10^{6}**	**This work**

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