Electronic Supplementary Material (ESI) for RSC Advances

Activated layered manganese oxide by nano-sized gold or silver as an efficient catalyst for epoxidation of olefins

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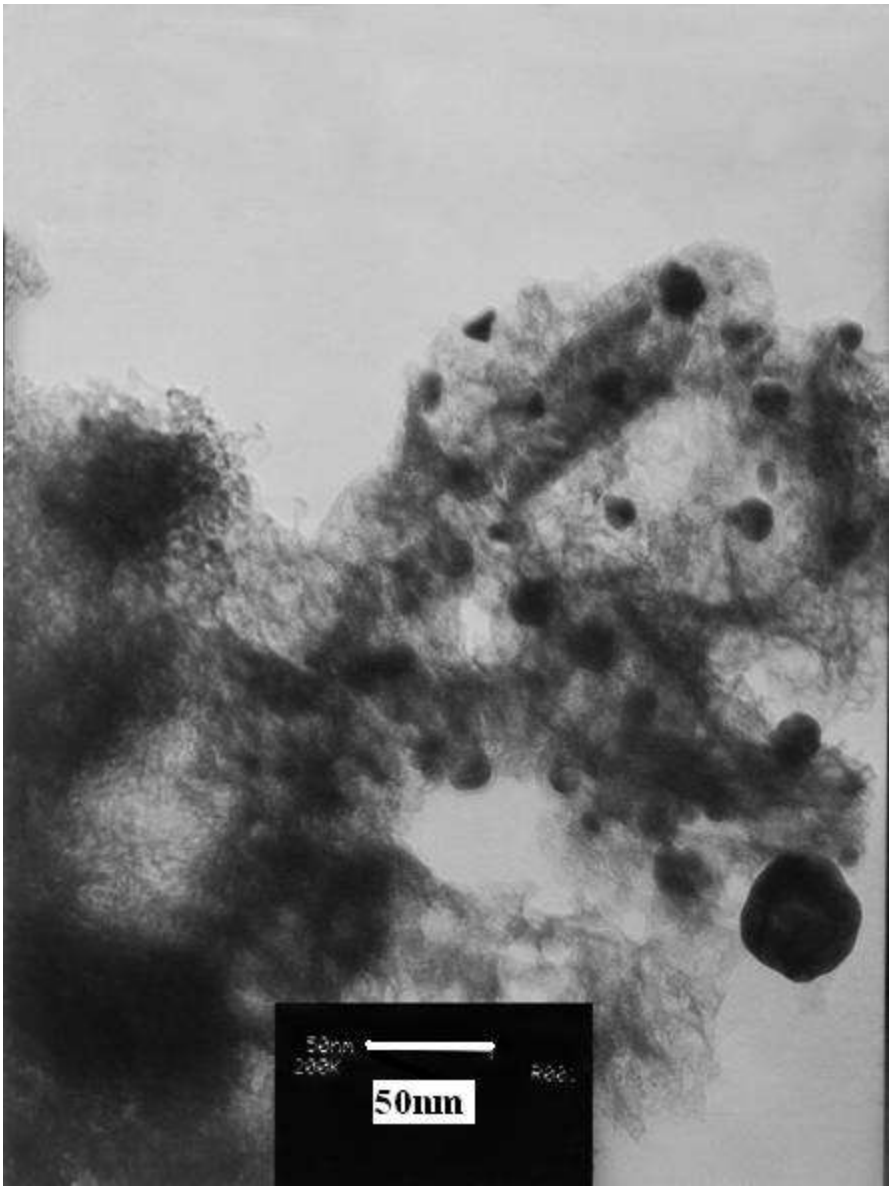
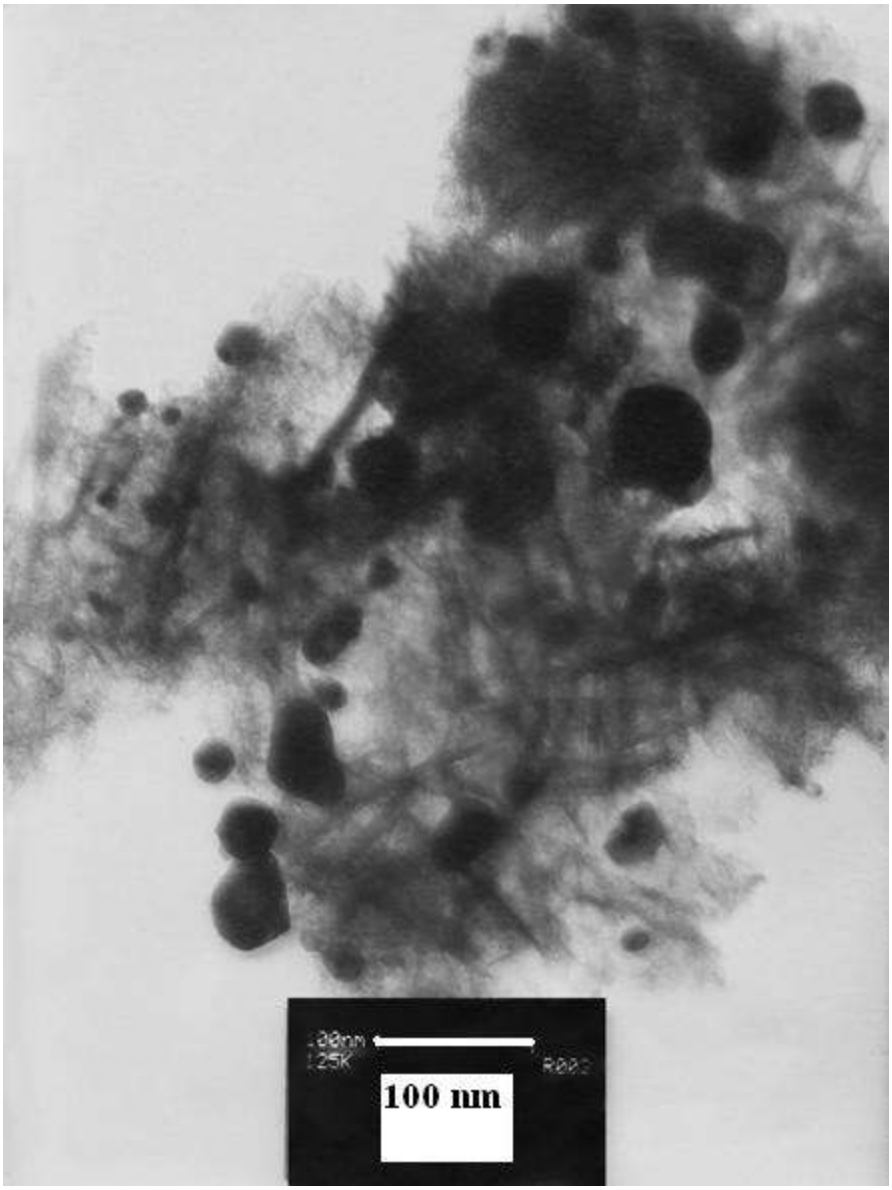


a



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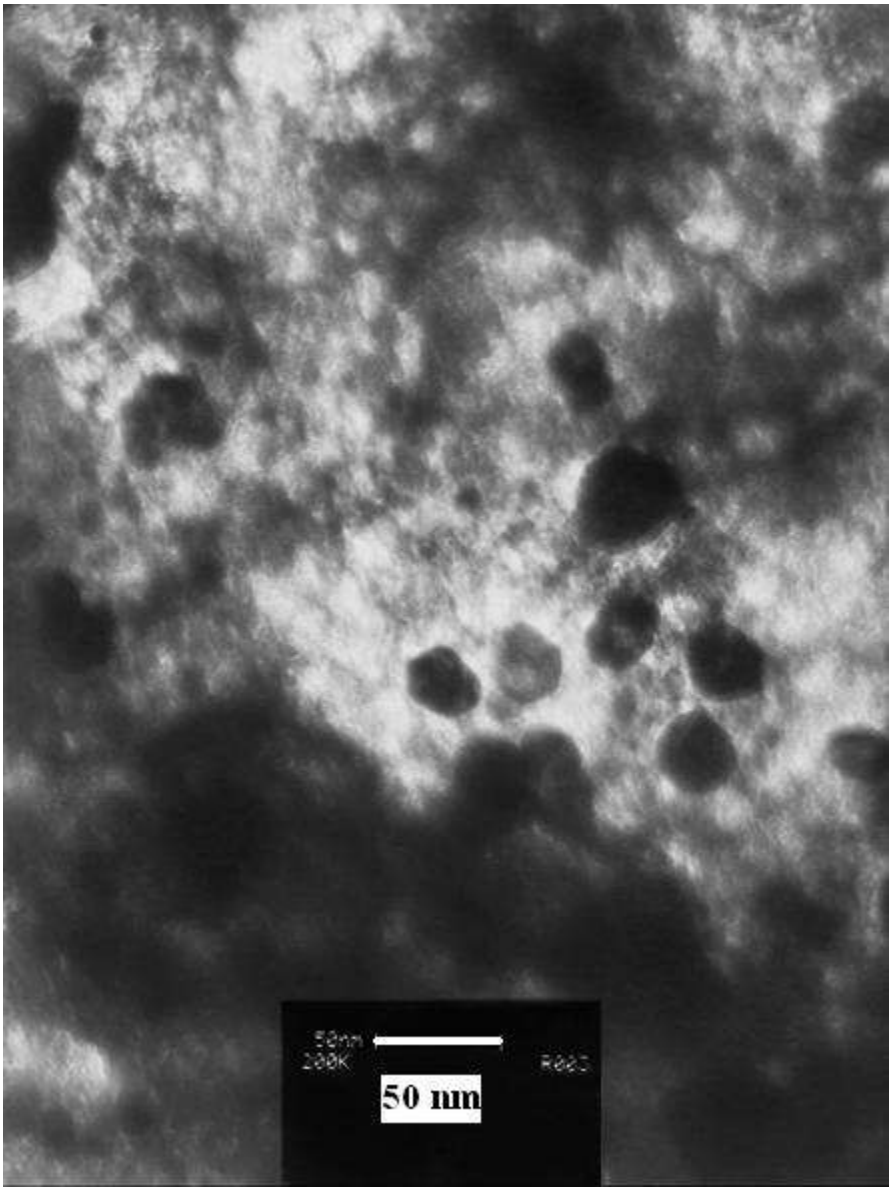
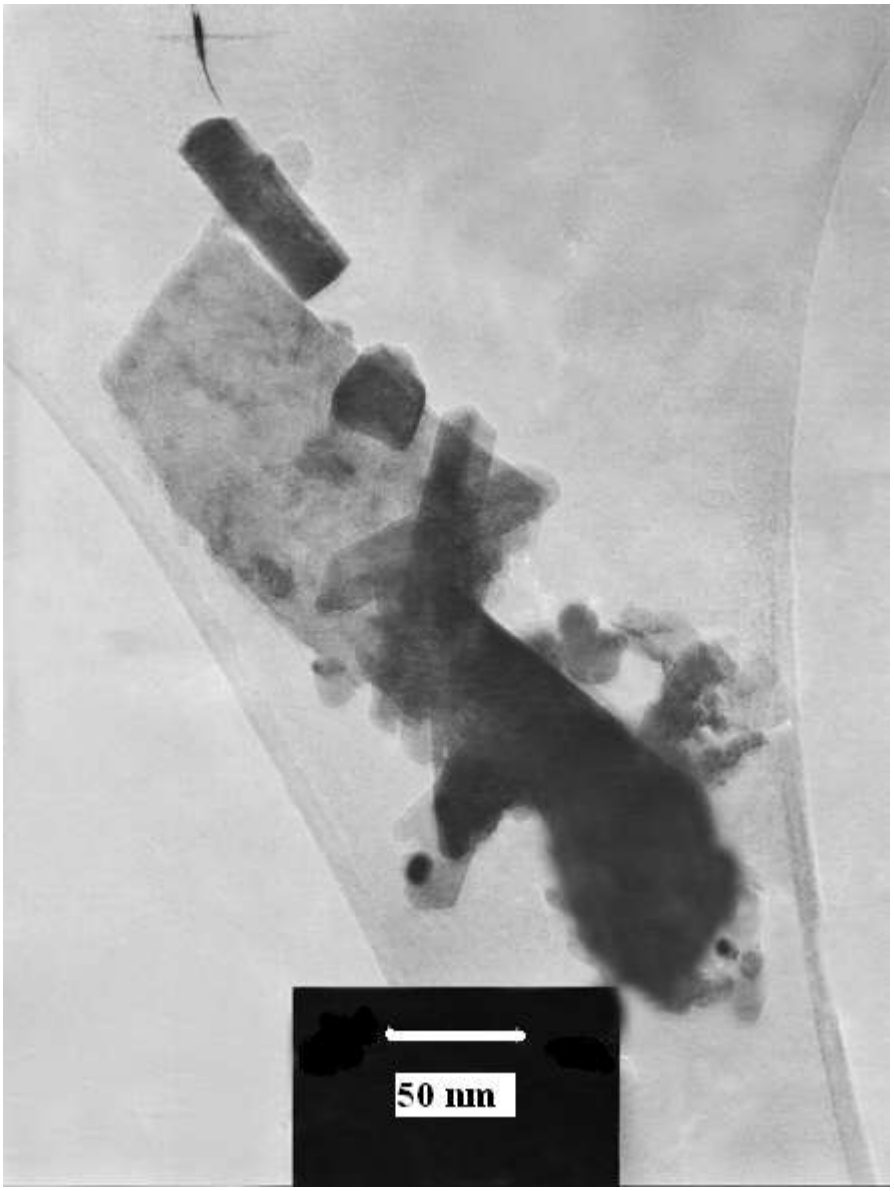


c

Fig. S1 TEM images of the gold (Au: 1.6%) deposited on layered manganese oxides (a-c).

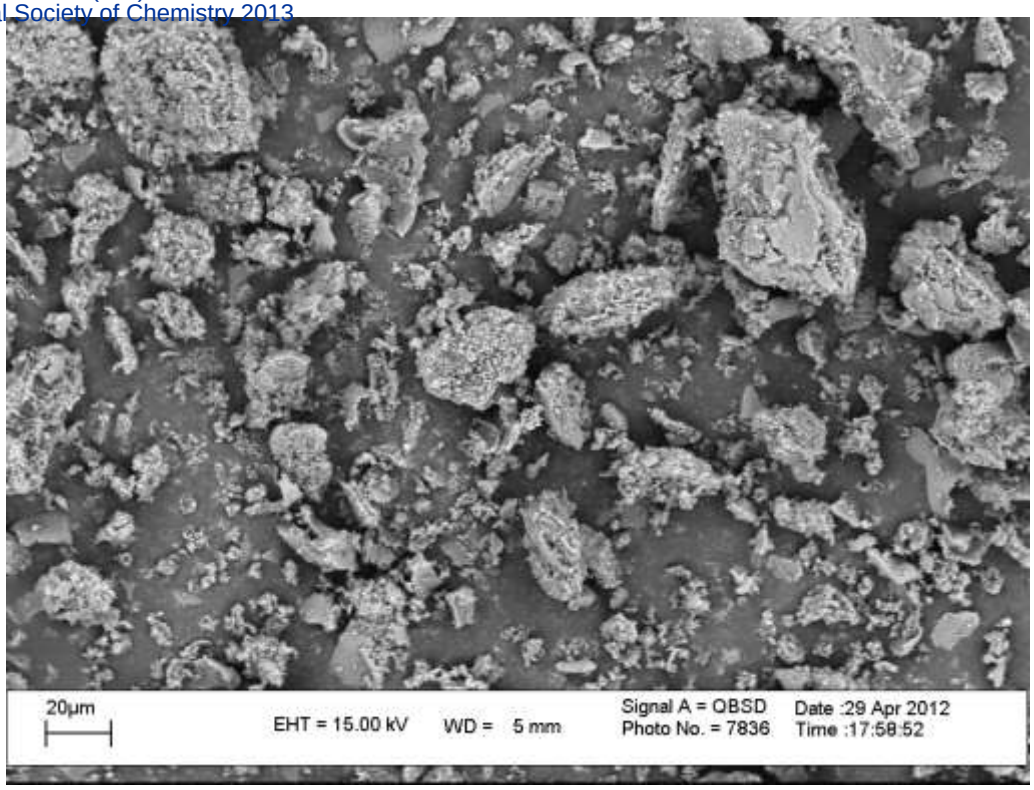
a



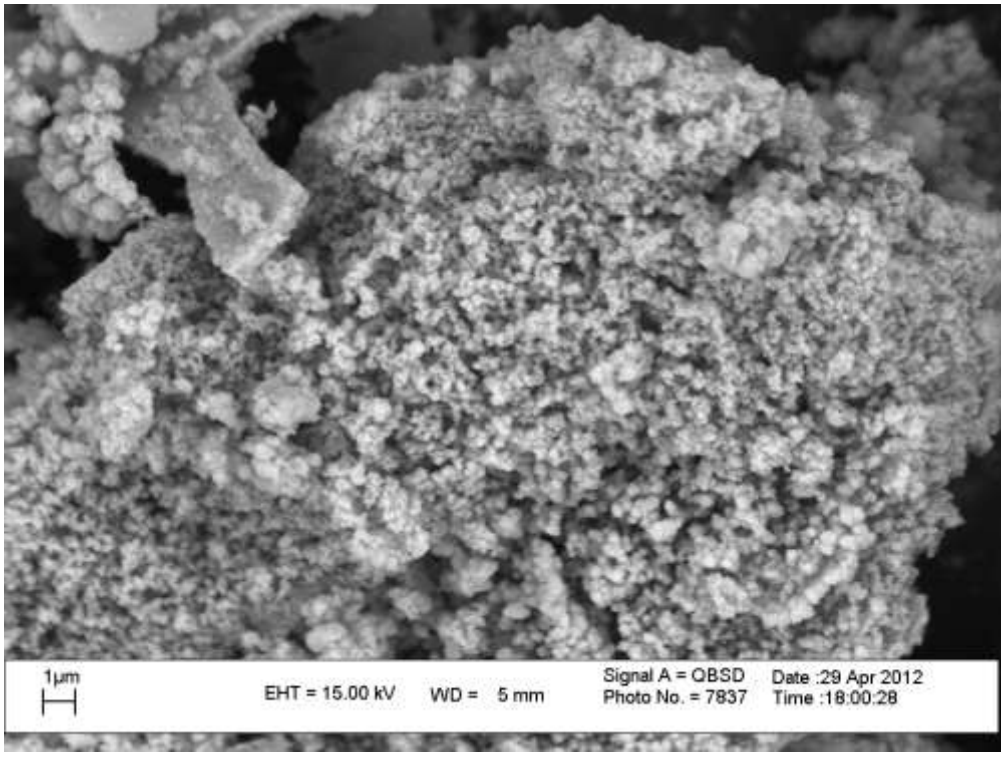
b

c

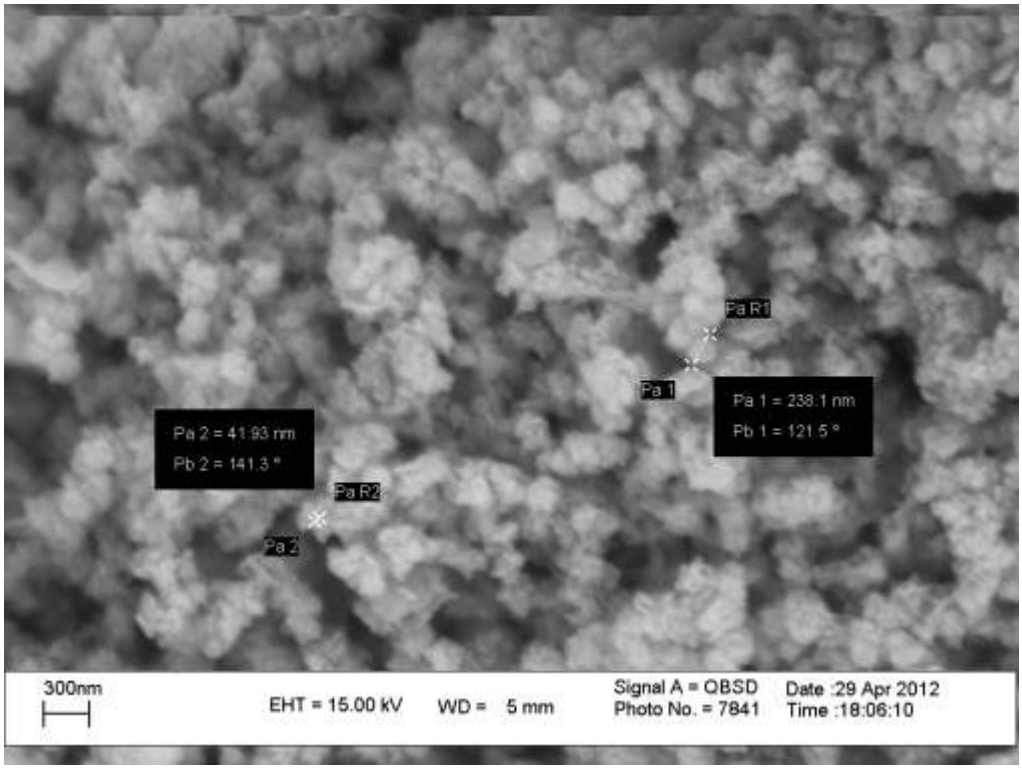
Fig. S2 TEM images of the silver (Ag: 3.38%) deposited on layered manganese oxides (a-c).



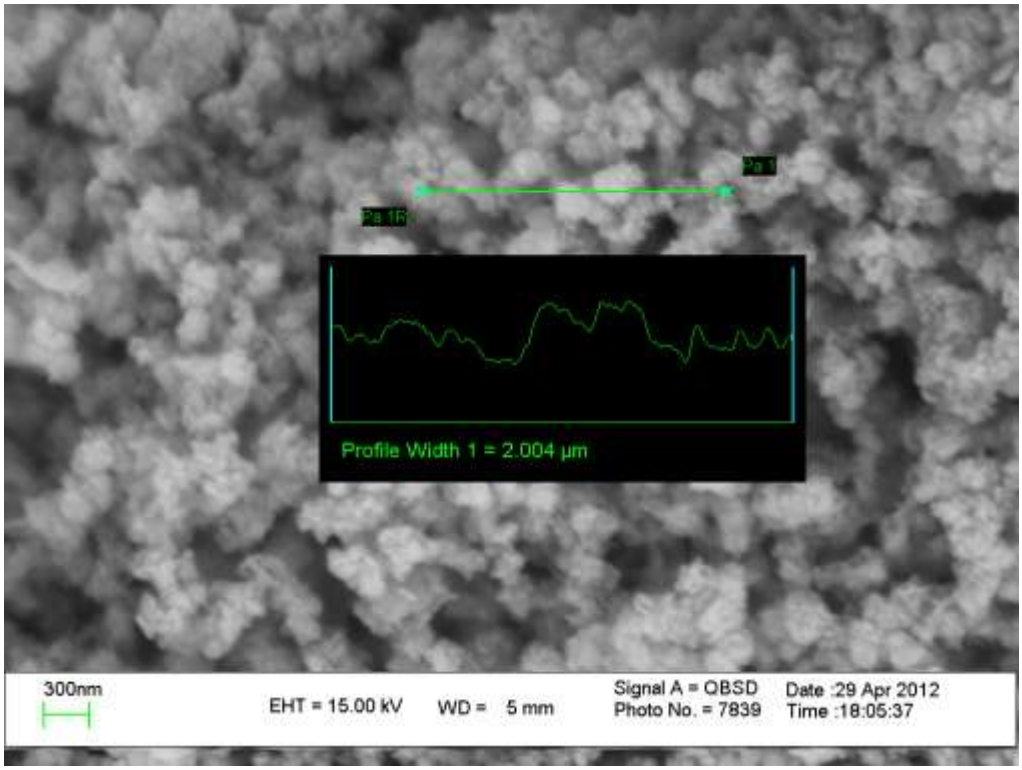
(a)



(b)

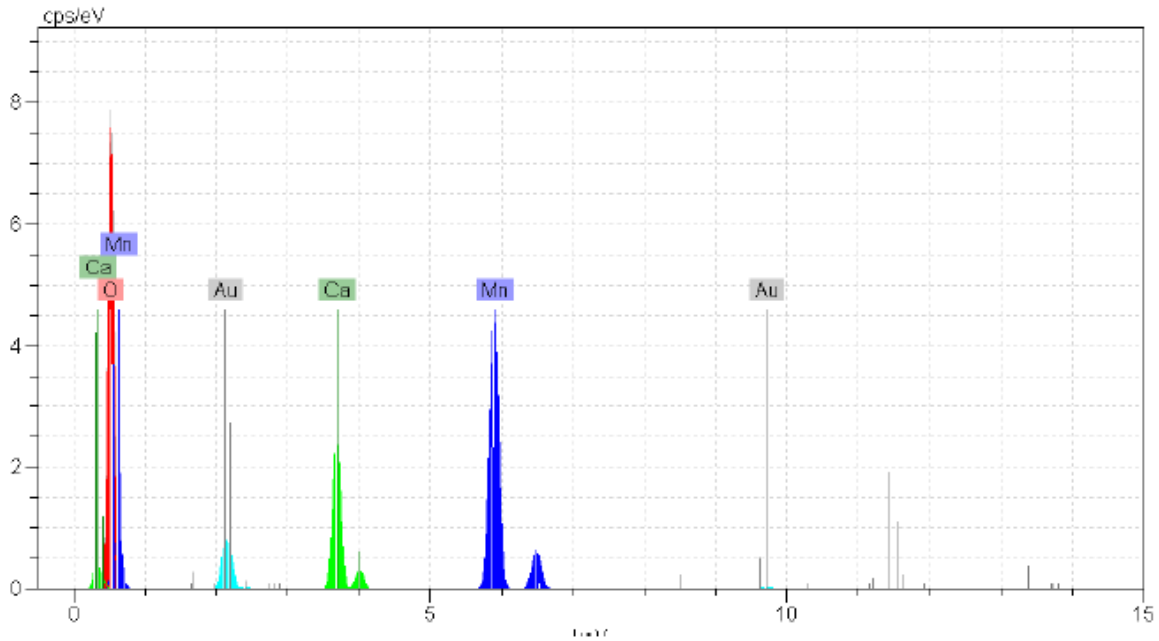


(c)



(d)

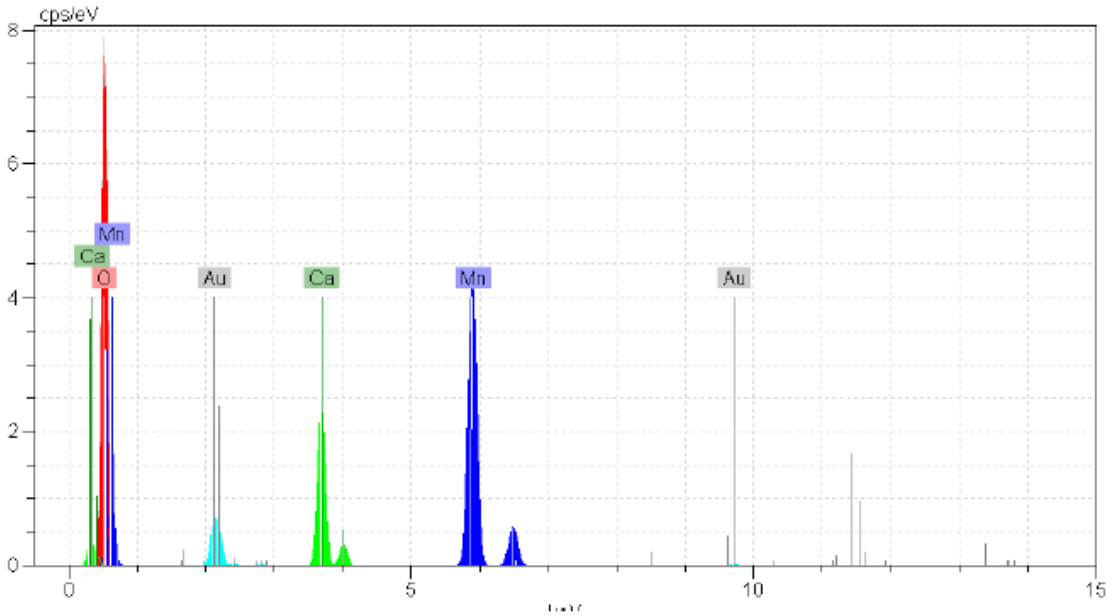
Fig. S3 SEM images of silver deposited (Ag: 7.5%) on layered manganese oxides (a-d).



Spectra of gold (0.7%) deposited layered manganese oxide point 1.

Element	Series	unn. C [wt.-%]	norm. C [wt.-%]	Atom. C [at.-%]
Oxygen	K series	26.09	26.32	54.88
Calcium	K series	10.01	10.10	8.41
Manganese	K series	58.72	59.24	35.98
Gold	M series	4.31	4.34	0.74
	Total:	99.1 %		

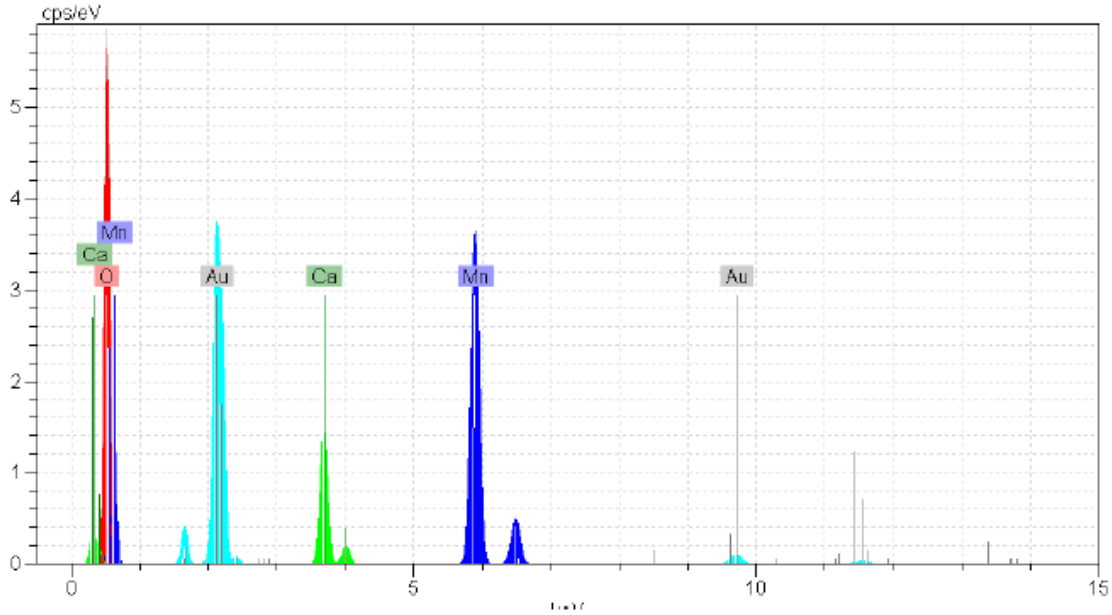
(a)



Spectra of gold (0.7%) deposited layered manganese oxide point 2.

Element	Series	unn. C [wt.-%]	norm. C [wt.-%]	Atom. C [at.-%]
Oxygen	K series	27.15	27.09	55.73
Calcium	K series	10.04	10.01	8.22
Manganese	K series	59.27	59.14	35.43
Gold	M series	3.76	3.75	0.63
	Total:	100.2 %		

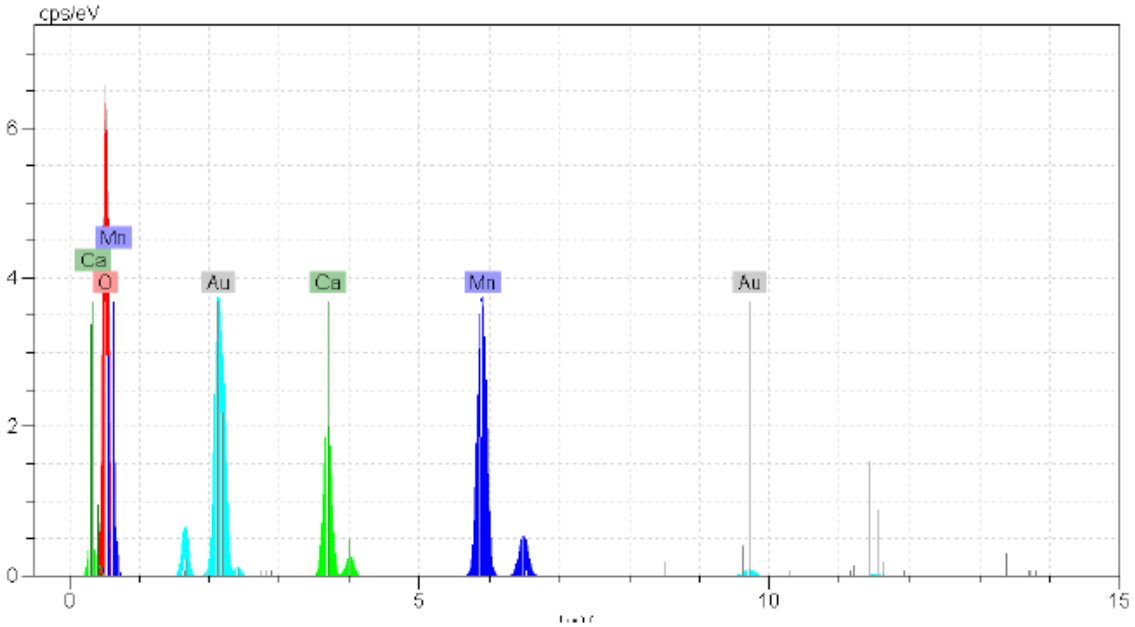
(b)



Spectra of gold (5.7%) deposited layered manganese oxide point 1.

Element	Series	unn. C [wt.-%]	norm. C [wt.-%]	Atom. C [at.-%]
Oxygen	K series	20.10	19.83	51.66
Calcium	K series	7.34	7.24	7.53
Manganese	K series	47.02	46.39	35.19
Gold	M series	26.88	26.53	5.61
	Total:	101.3 %		

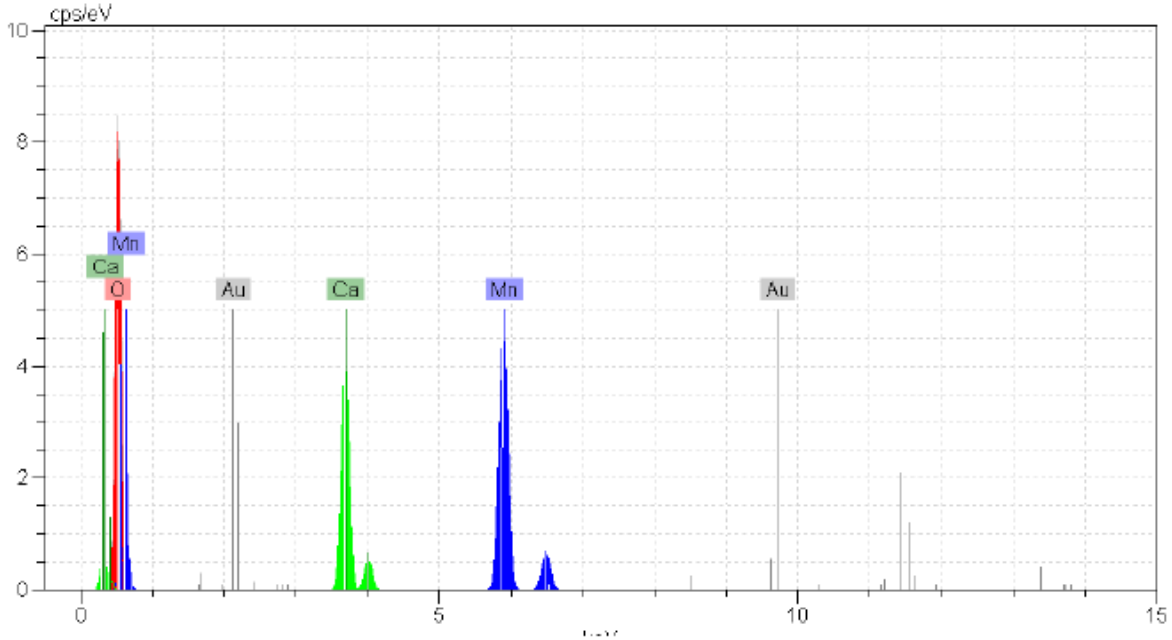
(c)



Spectra of gold (5.7%) deposited layered manganese oxide point 2.

Element	Series	unn. C [wt.-%]	norm. C [wt.-%]	Atom. C [at.-%]
Oxygen	K series	21.37	20.67	52.38
Calcium	K series	9.22	8.92	9.02
Manganese	K series	46.83	45.30	33.43
Gold	M series	25.97	25.12	5.17
	Total:	103.4 %		

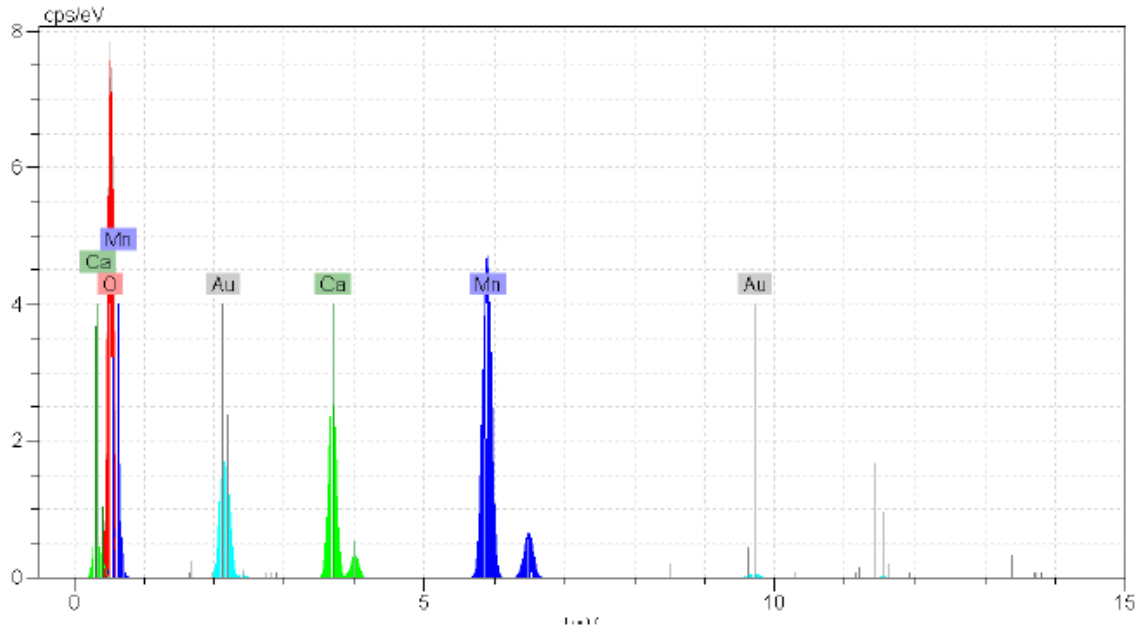
(d)



Spectra of layered manganese oxide.

Element	Series	unn. C [wt.-%]	norm. C [wt.-%]	Atom. C [at.-%]
Oxygen	K series	27.41	26.83	53.89
Calcium	K series	15.56	15.24	12.22
Manganese	K series	59.18	57.93	33.89
Gold	M series	0.00	0.00	0.00
	Total:	102.1 %		

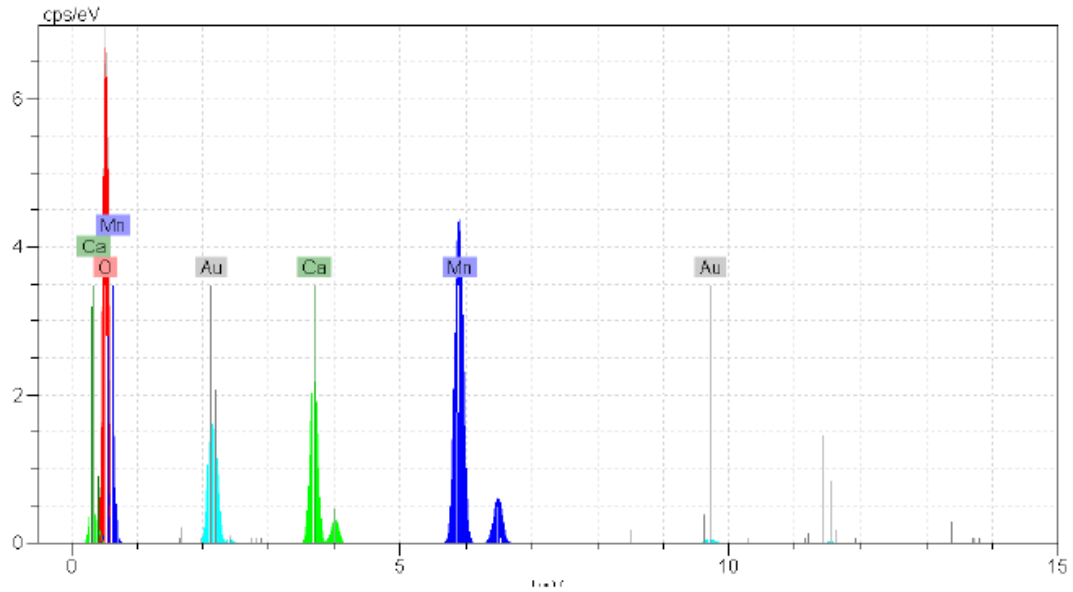
(e)



Spectra of gold (1.6%) deposited layered manganese oxide point 1.

Element	Series	unn. C [wt.-%]	norm. C [wt.-%]	Atom. C [at.-%]
Oxygen	K series	24.68	25.97	55.50
Calcium	K series	9.65	10.15	8.66
Manganese	K series	52.41	55.15	34.33
Gold	M series	8.31	8.74	1.52
	Total:	95.0 %		

(f)

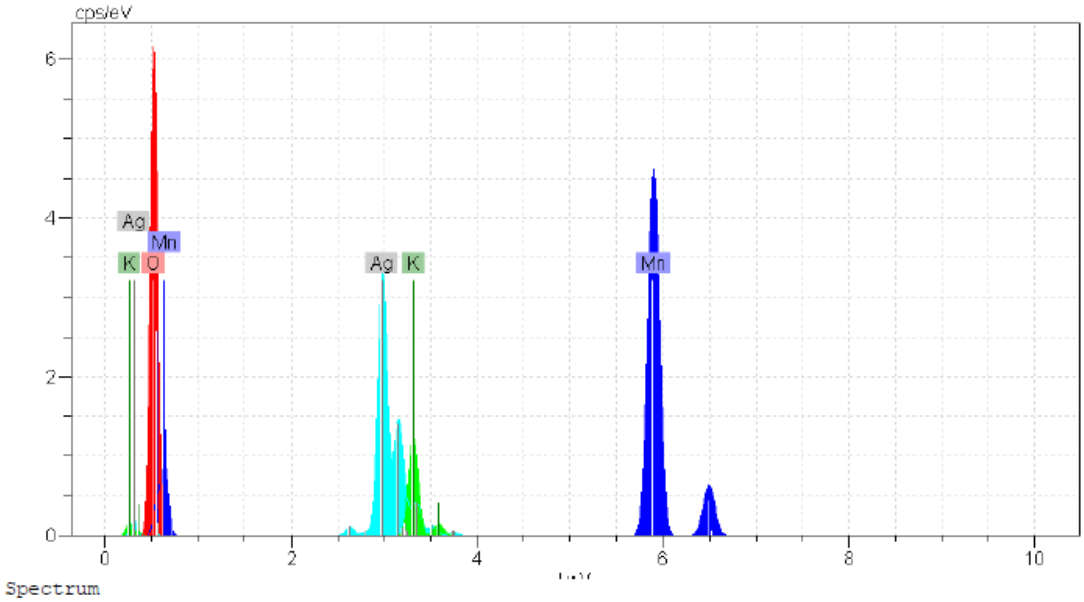


Spectra of gold (1.6%) deposited layered manganese oxides point 2.

Element	Series	unn. C [wt.-%]	norm. C [wt.-%]	Atom. C [at.-%]
Oxygen	K series	23.81	24.55	53.66
Calcium	K series	9.74	10.04	8.76
Manganese	K series	54.85	56.55	36.00
Gold	M series	8.60	8.87	1.57
	Total:	97.0 %		

(g)

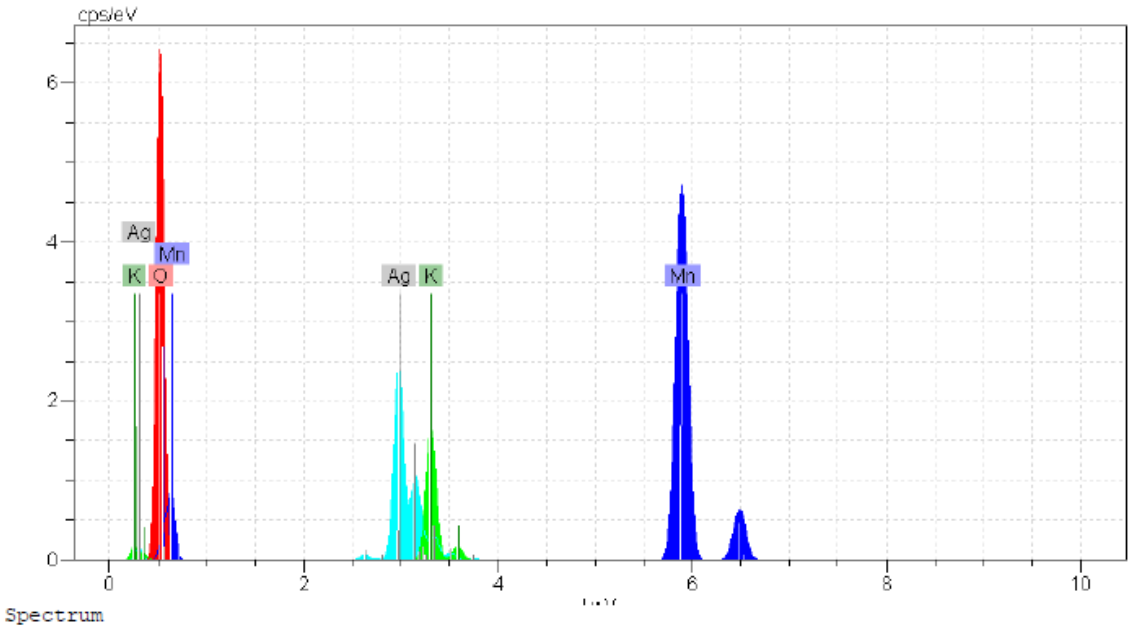
Fig. S4 EDX of gold deposited layered manganese oxides (a-g).



Spectra: Spectra for Ag(~ 7 %) on Layered manganese oxide

Element	Series	unn. C [wt.-%]	norm. C [wt.-%]	Atom. C [at.-%]
Oxygen	K series	23.35	22.69	53.27
Potassium	K series	4.03	3.92	3.76
Manganese	K series	53.39	51.90	35.48
Silver	L series	22.11	21.49	7.48
	Total:	102.9 %		

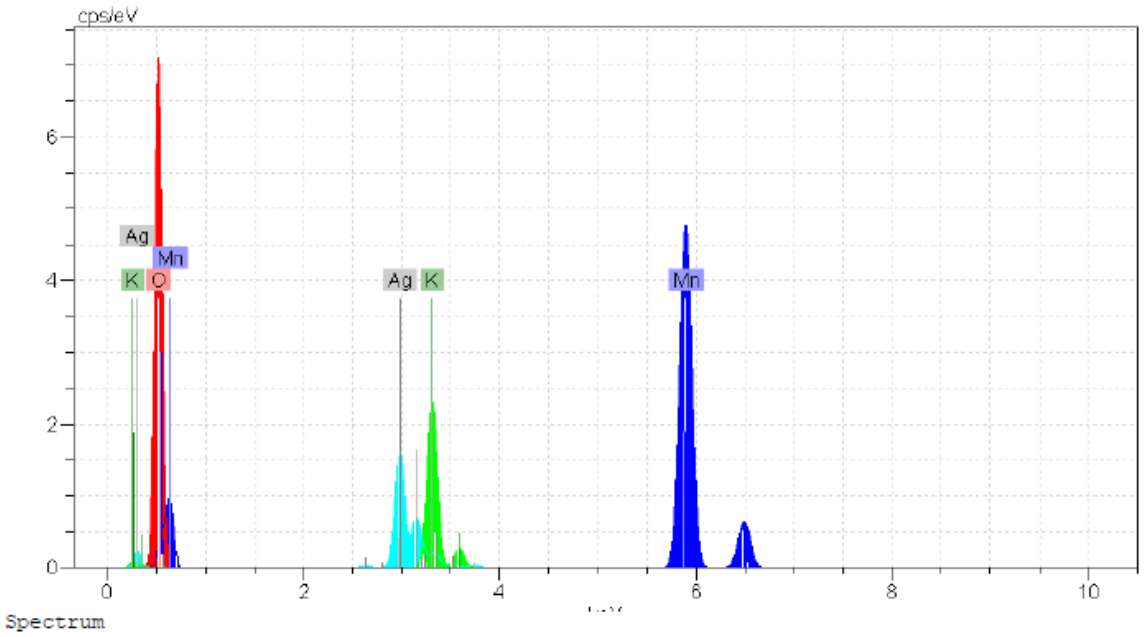
(a)



Spectra: Spectra for Ag(~ 5 %) on Layered manganese oxide

Element	Series	unn. C [wt.-%]	norm. C [wt.-%]	Atom. C [at.-%]
Oxygen	K series	23.62	23.00	52.56
Potassium	K series	5.39	5.25	4.91
Manganese	K series	57.29	55.80	37.13
Silver	L series	16.37	15.95	5.40
	Total:	102.7 %		

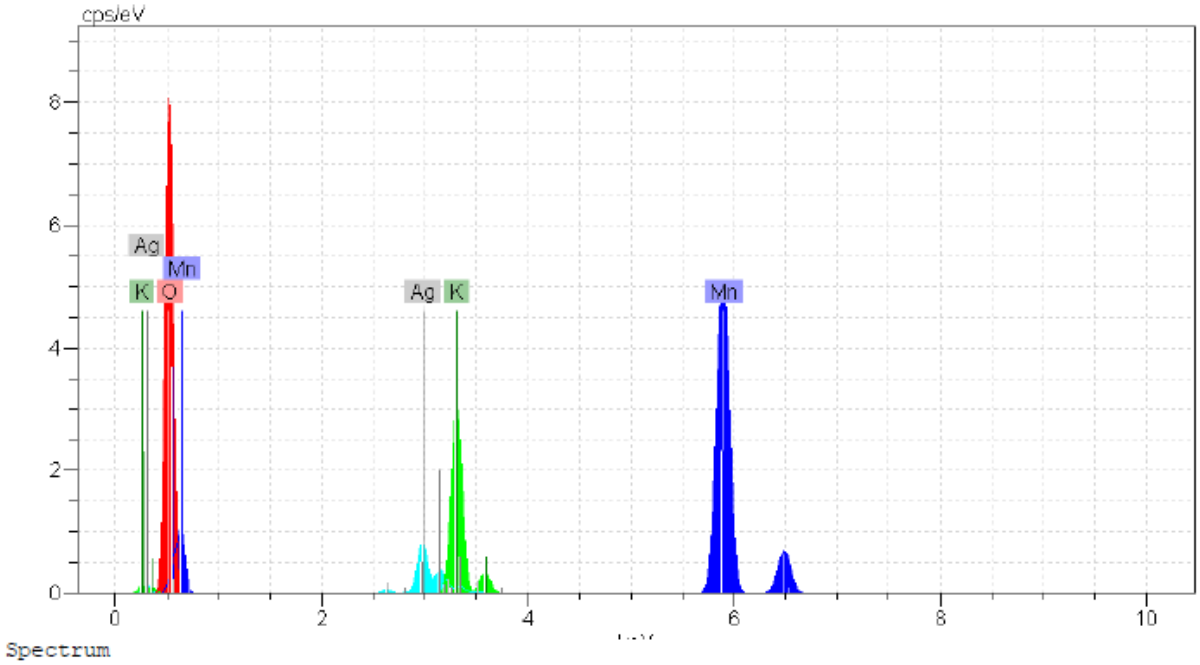
(b)



Spectra for Ag(~ 3%) on Layered manganese oxide

Element	Series	unn. C [wt.-%]	norm. C [wt.-%]	Atom. C [at.-%]
Oxygen	K series	24.82	24.71	53.70
Potassium	K series	7.54	7.51	6.68
Manganese	K series	57.54	57.28	36.24
Silver	L series	10.55	10.50	3.38
	Total:	100.5 %		

(c)



Spectra: Spectra for Ag(~ 1.6%) on Layered manganese oxide

Element	Series	unn. C [wt.-%]	norm. C [wt.-%]	Atom. C [at.-%]
Oxygen	K series	25.35	24.09	51.80
Potassium	K series	9.67	9.19	8.08
Manganese	K series	64.47	61.27	38.37
Silver	L series	5.74	5.46	1.74
	Total:	105.2 %		

(d)

Fig. S5 EDX of layered silver deposited layered manganese oxides (a-d).

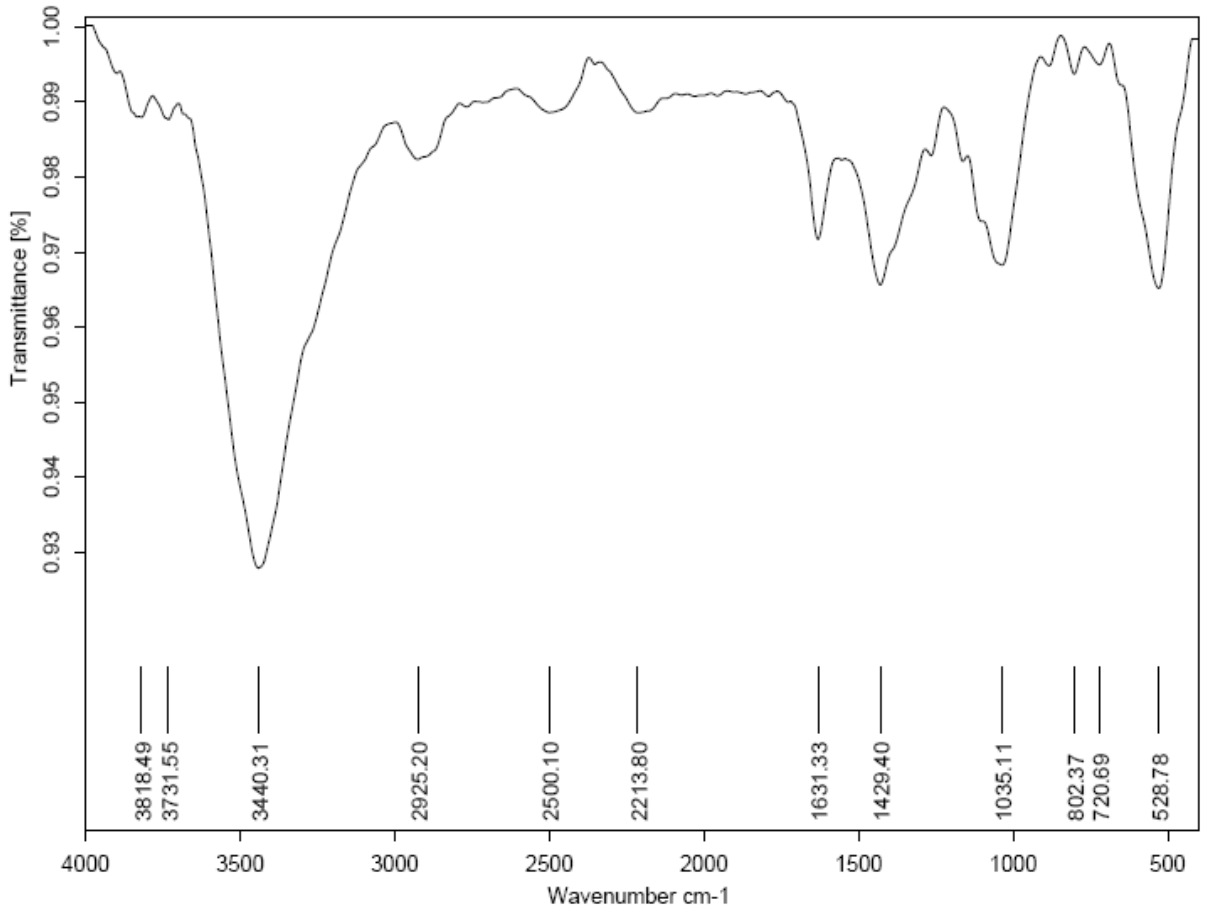


Fig. S6 IR spectrum of layered Mn oxide used for synthesis of Ag deposited on layered Mn oxide.

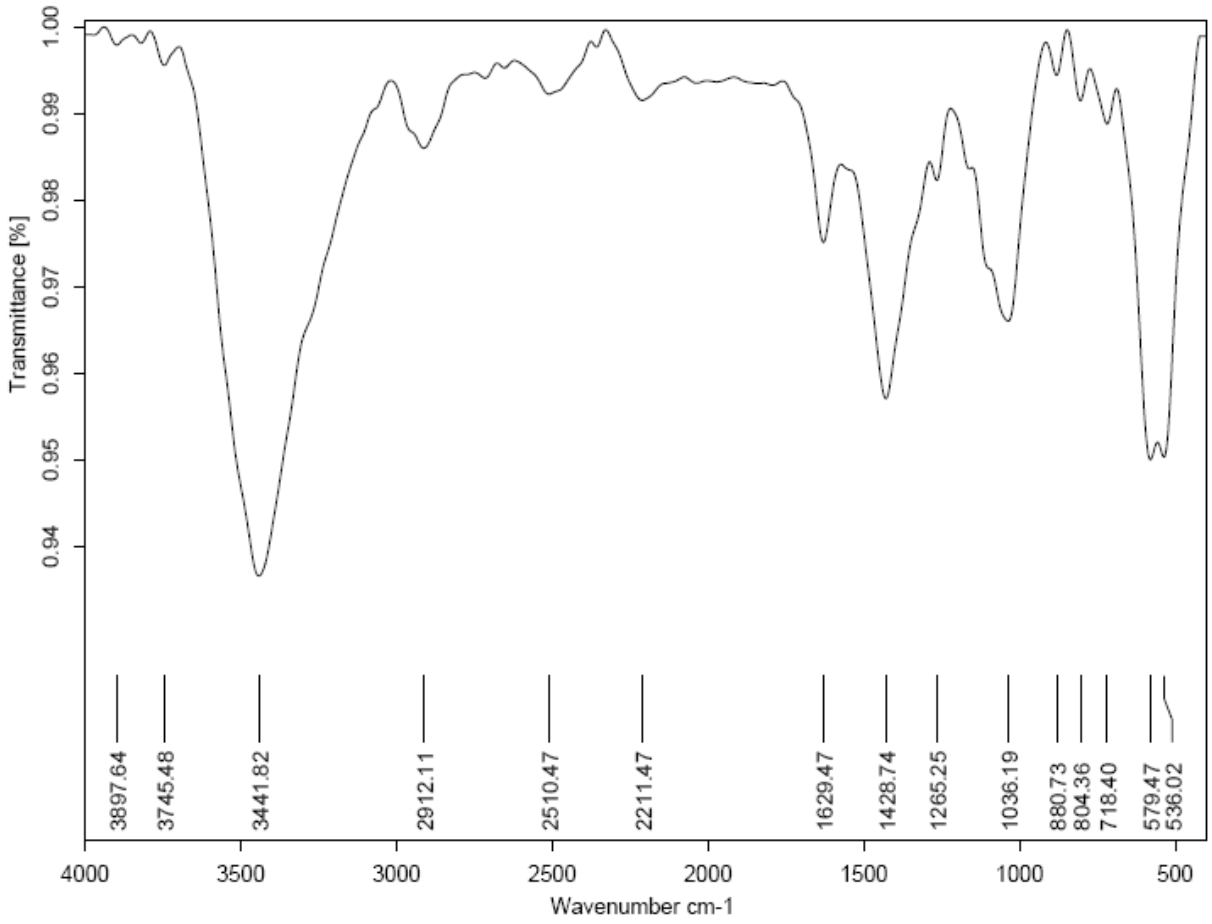


Fig. S7 IR spectrum of Ag deposited on layered Mn oxide (Ag: 7.48%).

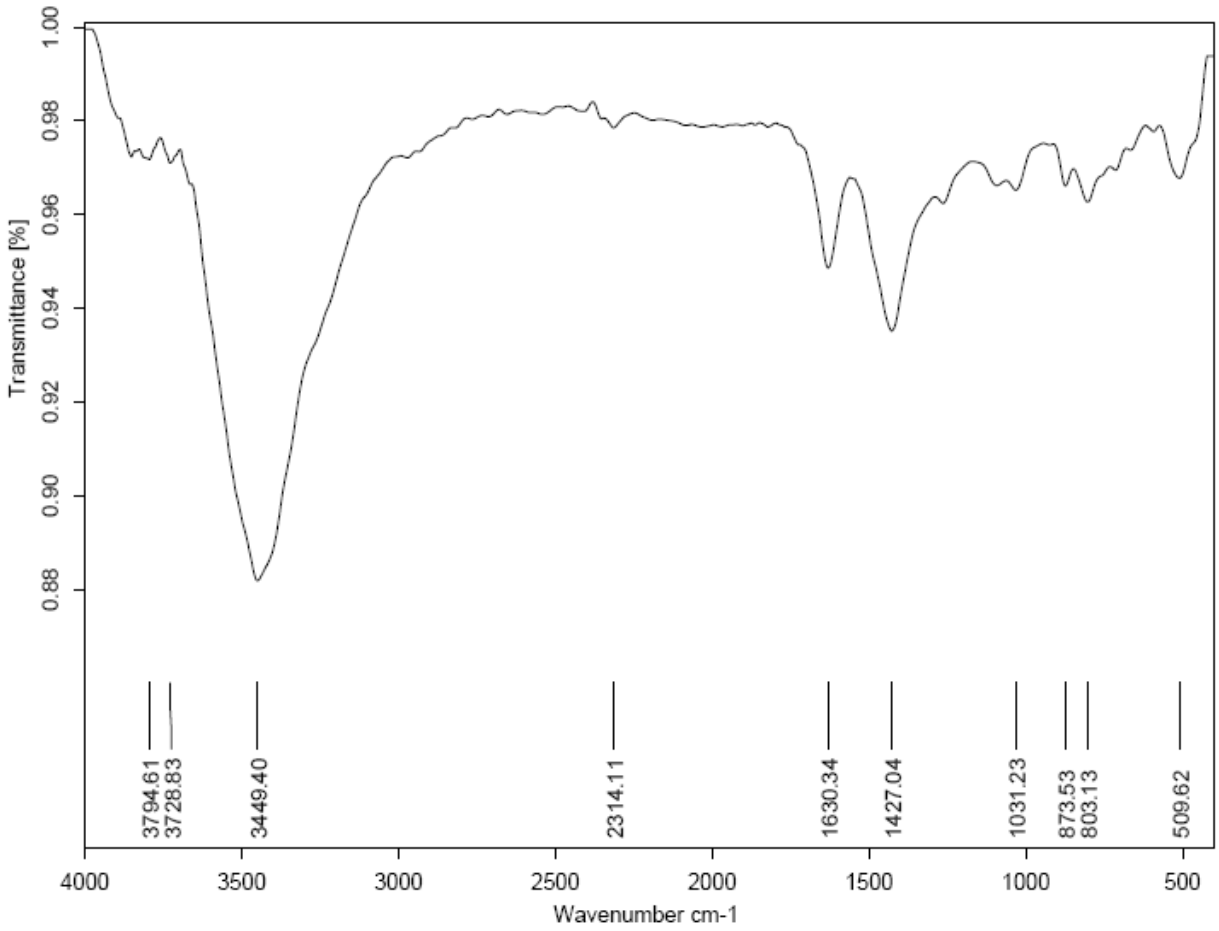


Fig. S8 IR spectrum of layered Mn oxide used for synthesis of Au deposited on layered Mn oxide.

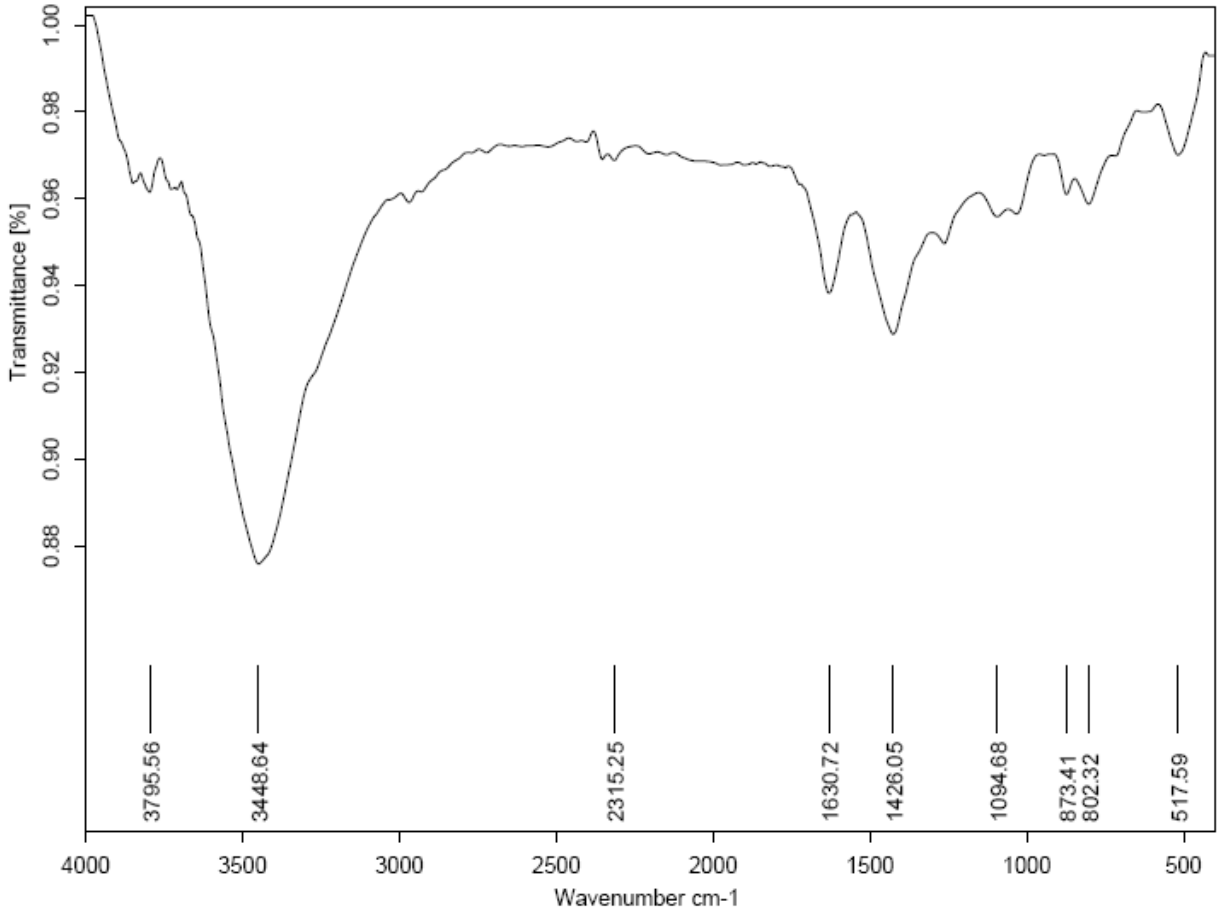


Fig. S9 IR spectrum of Au deposited on layered Mn oxide (Au: 1.6%).