

Recognition of Organic Compounds in Aqueous Solutions by Chemiluminescence on an Array of Catalytic Nanoparticles

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Table S1. The original data of CL intensity (a. u.) patterns for 14 solutions at 30 mM.

	MgO	ZrO ₂	SiO ₂	γ -Al ₂ O ₃	Y ₂ O ₃	SrCO ₃
Glucose	19700	5497	1254	10199	3168	2637
Glucose	19874	5368	1325	9534	3376	2448
Glucose	19632	5201	1242	9306	3300	2695
Glucose	19317	5009	1159	9618	3168	2495
Glucose	19050	5559	1159	9576	3088	2578
Sucrose	11769	2927	796	3420	2591	2713
Sucrose	11879	2819	764	3365	2641	2535
Sucrose	12005	2765	775	3343	2716	2520
Sucrose	11949	2836	798	3402	2911	2520
Sucrose	12297	2782	733	3407	2786	2501
Maltose	10882	5037	806	3255	2262	1357
Maltose	11206	4997	754	3300	2115	1397
Maltose	10670	4817	755	3404	2126	1303
Maltose	10697	4699	747	3061	2035	1318
Maltose	11044	4761	851	3359	1859	1357
Ascorbic acid	13905	1647	550	2087	1168	2349
Ascorbic acid	14019	1620	576	2265	1137	2571
Ascorbic acid	17558	1653	585	2337	1179	2425
Ascorbic acid	15635	1659	573	2170	1126	2512
Ascorbic acid	14497	1614	622	2359	1200	2453
Lactic acid	3106	323	443	287	0	2585
Lactic acid	3143	300	396	301	0	2520
Lactic acid	3147	331	379	273	0	2436
Lactic acid	3159	356	355	276	0	2520
Lactic acid	3195	342	384	287	0	2470
L-Val	4532	3341	937	3351	6337	5639
L-Val	4403	3251	1172	3206	6198	5821
L-Val	4289	3162	1010	3057	6587	5606
L-Val	4418	3280	1024	2977	6291	5996
L-Val	4304	3459	965	3320	5901	6030
L-Try	25140	9692	3380	8141	8784	9467
L-Try	24357	9632	3325	7894	8961	9756
L-Try	25014	9895	3303	8046	9442	9433

L-Try	25418	9945	3515	7866	9400	9682
L-Try	25822	9733	3362	7687	9315	9857
L-Phe	10785	6696	2953	9595	1594	2103
L-Phe	10497	6830	3205	9928	1449	2143
L-Phe	10721	6703	3278	10071	1414	2130
L-Phe	10772	6435	3351	10215	2131	2156
L-Phe	10444	6611	3337	10027	1494	2209
L-Ser	4200	786	83	1256	603	240
L-Ser	4253	804	88	1285	568	208
L-Ser	3970	768	76	1234	580	175
L-Ser	3835	816	92	1160	598	192
L-Ser	3700	733	83	1219	580	181
L-Lys	3571	1314	383	1055	1497	1354
L-Lys	3454	1263	385	1026	1515	1363
L-Lys	3571	1179	387	1098	1561	1345
L-Lys	3593	1108	318	1067	1544	1383
L-Lys	3559	1334	386	1222	1575	1431
L-Ile	19077	4604	704	2173	2235	4696
L-Ile	18676	4498	725	2142	2190	4520
L-Ile	18521	4604	767	2201	2176	4572
L-Ile	18429	4579	715	2378	2219	4520
L-Ile	18274	4654	674	2173	2101	4596
L-Leu	9519	2614	223	1863	1373	5497
L-Leu	9724	2573	209	2085	1336	5379
L-Leu	9122	2749	230	2220	1325	5794
L-Leu	8878	2582	202	2248	1300	5676
L-Leu	9198	2672	230	2085	1350	5766
L-Cys·HCl	4402	600	277	638	815	390
L-Cys·HCl	4446	507	317	717	804	408
L-Cys·HCl	4375	491	344	753	734	416
L-Cys·HCl	4424	573	320	718	815	411
L-Cys·HCl	4468	507	317	674	757	461
L-Met	5894	539	231	1501	628	1077
L-Met	6116	605	240	1451	700	1060
L-Met	6185	645	275	1388	549	1100
L-Met	6330	652	280	1366	611	1150
L-Met	6261	631	240	1388	563	1176

Table S2. The average CL intensities (n=5) for 14 solutions at 15, 30 and 45 mM.

	C.	MgO	ZrO ₂	SiO ₂	γ -Al ₂ O ₃	Y ₂ O ₃	SrCO ₃
Glucose	15 mM	10995.6	3316.6	744.2	6579.6	2330.2	1549.6
Glucose	30 mM	19514.6	5326.8	1227.8	9646.6	3220	2570.6
Glucose	45 mM	25907.2	7098	1450.6	11742.2	3342.2	3390.4
Sucrose	15 mM	7337.4	1732.4	622.2	2376.6	1621.8	1502.8

Sucrose	30 mM	11979.8	2825.8	773.2	3387.4	2729	2557.8
Sucrose	45 mM	16485.4	3572.2	945.8	4670	3575.8	3782.4
Maltose	15 mM	6959.4	3264.2	586.6	2403.8	1765	703.6
Maltose	30 mM	10899.8	4862.2	782.6	3275.8	2079.4	1346.4
Maltose	45 mM	14592	6409	1024.6	3735	2643	1551
Ascorbic acid	15 mM	12608	948.4	420.6	1544.6	677.4	1451.2
Ascorbic acid	30 mM	15122.8	1638.6	581.2	2243.6	1162	2462
Ascorbic acid	45 mM	18026.8	2332.6	816	2722.8	1653.6	3628.8
Lactic acid	15 mM	1511.6	176.8	0	162.2	0	1206.2
Lactic acid	30 mM	3150	330.4	391.4	284.8	0	2506.2
Lactic acid	45 mM	4252.4	556.8	469	516.6	630.4	4331.8
L-Val	15 mM	2199.6	1610.8	630.6	2152.2	3936.4	3014
L-Val	30 mM	4389.2	3298.6	1021.6	3182.2	6262.8	5818.4
L-Val	45 mM	6607.2	5291.4	1334.2	3603.2	7239.8	8238.8
L-Try	15 mM	17351.2	5520	2320.2	5203.8	4790.6	5275.6
L-Try	30 mM	25150.2	9779.4	3377	7926.8	9180.4	9639
L-Try	45 mM	32968.6	14060.2	4617.4	10568	13272	14241
L-Phe	15 mM	5578	3057	2380.4	5028.8	814.6	1030.8
L-Phe	30 mM	10643.8	6655	3224.8	9967.2	1616.4	2148.2
L-Phe	45 mM	15320.4	10747.2	3537.8	15185.8	2584.8	3582.4
L-Ser	15 mM	2741.8	565.4	0	835.2	456.6	154.6
L-Ser	30 mM	3991.6	781.4	84.4	1230.8	585.8	199.2
L-Ser	45 mM	5284.6	987.6	114.4	1392.8	772.8	245
L-Lys	15 mM	1717.6	880.4	0	457.4	612	564.8
L-Lys	30 mM	3549.6	1239.6	371.8	1093.6	1538.4	1375.2
L-Lys	45 mM	6133.2	1586.2	549.6	1847	2481	2474.2
L-Ile	15 mM	12129	2232.4	588.4	966.8	1433.2	2604.6
L-Ile	30 mM	18595.4	4587.8	717	2213.4	2184.2	4580.8
L-Ile	45 mM	20136.6	6086.2	1075.6	3305.2	2703.2	7021.4
L-Leu	15 mM	5579.8	1399	120	1271.4	953.2	2902.6
L-Leu	30 mM	9288.2	2638	218.8	2100.2	1336.8	5622.4
L-Leu	45 mM	11445.2	3794.2	282.6	2746.4	1603	8778.8
L-Cys·HCl	15 mM	3216.6	325.2	146.4	473.8	517.6	256.6
L-Cys·HCl	30 mM	4423	535.6	315	700	785	417.2
L-Cys·HCl	45 mM	5879.2	717.6	506	997.2	1166	724.4
L-Met	15 mM	2748.2	340.8	151.8	882.4	353.6	542.6
L-Met	30 mM	6157.2	614.4	253.2	1418.8	610.2	1112.6
L-Met	45 mM	11402.8	1037.4	326	2195.8	1084.8	1927.2

Table S3. Identification of 126 unknown samples.

#	CL responses patterns (a. u.)						Identification		Verification ^c
	A	B	C	D	E	F ^a	ID	C. ^b	
1	25868	9520	3438	7602	9265	10039	L-Try	30	30 L-Try
2	10659	5233	799	3003	2038	1352	Maltose	30	30 maltose

3	3151	335	360	355	0	2504	Lactic acid	30	30 lactic acid
4	5983	1575	480	1885	2365	2498	L-Lys	45	45 L-Lys
5	5033	934	101	1412	698	207	L-Ser	45	45 L-Ser
6	4332	554	301	761	829	430	L-Cys·HCl	30	30 L-Cys·HCl
7	12276	2213	641	928	1269	2631	L-Ile	15	15 L-Ile
8	9160	2460	216	2206	1308	5676	L-Leu	30	30 L-Leu
9	4201	499	455	521	638	4342	Lactic acid	45	45 lactic acid
10	1612	166	0	146	0	1056	Lactic acid	15	15 lactic acid
11	10844	3672	300	2806	1583	8601	L-Leu	45	45 L-Leu
12	32468	13523	4707	10900	13593	13854	L-Try	45	45 L-Try
13	4132	496	437	546	593	4376	Lactic acid	45	45 lactic acid
14	19602	6013	1191	3154	2477	7288	L-Ile	45	45 L-Ile
15	3448	710	78	1212	603	175	L-Ser	30	30 L-Ser
16	2605	320	153	859	371	549	L-Met	15	15 L-Met
17	14448	6446	1028	3682	2508	1595	Maltose	45	45 maltose
18	6172	1626	622	1832	2367	2525	L-Lys	45	45 L-Lys
19	6336	5408	1434	3504	7068	8442	L-Val	45	45 L-Val
20	11276	1104	293	2235	1095	1946	L-Met	45	45 L-Met
21	5884	705	505	967	1200	732	L-Cys·HCl	45	45 L-Cys·HCl
22	7017	1701	545	2310	1688	1479	Sucrose	15	15 sucrose
23	9996	6654	3351	10313	1445	2224	L-Phe	30	30 L-Phe
24	6739	3241	569	2319	1792	739	Maltose	15	15 maltose
25	20019	6201	1087	3227	2453	7264	L-Ile	45	45 L-Ile
26	5782	2973	2173	5157	726	1064	L-Phe	15	15 L-Phe
27	3247	336	164	524	569	253	L-Cys·HCl	15	15 L-Cys·HCl
28	10675	3379	724	6518	2395	1406	Glucose	15	15 glucose
29	1596	154	0	139	0	1136	Lactic acid	15	15 lactic acid
30	18345	2350	859	2745	1671	3767	VC ^d	45	45 VC
31	10832	4672	792	3387	2010	1444	Maltose	30	30 maltose
32	10646	3865	277	2834	1517	8781	L-Leu	45	45 L-Leu
33	3682	710	89	1175	521	173	L-Ser	30	30 L-Ser
34	19107	5269	1182	9306	2895	2459	Glucose	30	30 glucose
35	15578	1609	611	2182	1220	2366	VC	30	30 VC
36	5610	1280	109	1289	920	2925	L-Leu	15	15 L-Leu
37	6324	5172	1449	3618	7023	8375	L-Val	45	45 L-Val
38	14500	6267	967	3696	2564	1610	Maltose	45	45 maltose
39	15778	10638	3594	15321	2440	3568	L-Phe	45	45 L-Phe
40	5086	1057	151	1426	703	221	L-Ser	45	45 L-Ser
41	16371	3439	973	4555	3548	4117	Sucrose	45	45 sucrose
42	4402	503	325	674	816	465	L-Cys·HCl	30	30 L-Cys·HCl
43	9076	2785	226	2189	1261	6030	L-Leu	30	30 L-Leu
44	17675	4685	786	2364	2149	4572	L-Ile	30	30 L-Ile
45	4286	3397	991	3285	6531	6030	L-Val	30	30 L-Val
46	11021	3150	709	6030	2527	1370	Glucose	15	15 glucose

47	16197	3304	854	4325	3494	3854	Sucrose	45	45 sucrose
48	19005	2236	772	2731	1847	3503	VC	45	45 VC
49	17838	5681	2303	5039	4700	5457	L-Try	15	15 L-Try
50	25671	9844	3420	7569	9762	9574	L-Try	30	30 L-Try
51	12061	2779	710	3438	2925	2520	Sucrose	30	30 sucrose
52	18566	5025	1040	9003	2794	2578	Glucose	30	30 glucose
53	1823	849	0	444	665	606	L-Lys	15	15 L-Lys
54	14437	6211	1049	3741	2620	1590	Maltose	45	45 maltose
55	2639	393	157	849	315	540	L-Met	15	15 L-Met
56	2700	601	0	894	497	152	L-Ser	15	15 L-Ser
57	15619	1616	575	2029	1192	2470	VC	30	30 VC
58	4452	3251	1036	2993	6003	5855	L-Val	30	30 L-Val
59	3431	274	142	462	557	235	L-Cys-HCl	15	15 L-Cys-HCl
60	11812	907	381	1359	738	1435	VC	15	15 VC
61	5792	694	484	914	1332	710	L-Cys-HCl	45	45 L-Cys-HCl
62	19603	6282	1230	2991	2524	7111	L-Ile	45	45 L-Ile
63	11718	1031	315	2184	1199	1965	L-Met	45	45 L-Met
64	33251	13411	4325	10976	12994	14052	L-Try	45	45 L-Try
65	18471	2312	842	2720	1684	3784	VC	45	45 VC
66	12112	2319	590	942	1525	2620	L-Ile	15	15 L-Ile
67	3084	299	179	543	615	249	L-Cys-HCl	15	15 L-Cys-HCl
68	5104	1005	116	1449	733	246	L-Ser	45	45 L-Ser
69	1526	142	0	149	0	1106	Lactic acid	15	15 lactic acid
70	1846	818	0	441	665	626	L-Lys	15	15 L-Lys
71	4321	3369	1066	3026	6439	5888	L-Val	30	30 L-Val
72	2592	594	0	871	527	154	L-Ser	15	15 L-Ser
73	4148	530	413	540	620	4243	Lactic acid	45	45 lactic acid
74	6974	1684	539	2362	1705	1430	Sucrose	15	15 sucrose
75	1891	767	0	434	682	615	L-Lys	15	15 L-Lys
76	6678	3162	539	2409	1876	745	Maltose	15	15 maltose
77	8519	2654	213	2078	1319	5530	L-Leu	30	30 L-Leu
78	16002	10242	3652	15058	2390	3487	L-Phe	45	45 L-Phe
79	3687	1219	356	1098	1548	1431	L-Lys	30	30 L-Lys
80	6421	5443	1271	3482	7171	8159	L-Val	45	45 L-Val
81	16716	1655	505	2159	1206	2349	VC	30	30 VC
82	11748	2836	715	3533	2837	2633	Sucrose	30	30 sucrose
83	6050	1584	540	1863	2353	2575	L-Lys	45	45 L-Lys
84	2123	1712	595	1917	4733	2877	L-Val	15	15 L-Val
85	6454	599	227	1414	478	1161	L-Met	30	30 L-Met
86	24815	7055	1359	11488	3644	3288	Glucose	45	45 glucose
87	5546	2838	2391	5103	602	1092	L-Phe	15	15 L-Phe
88	17845	4629	653	2260	2000	4649	L-Ile	30	30 L-Ile
89	5330	1240	117	1213	920	3015	L-Leu	15	15 L-Leu
90	3155	289	337	281	0	2421	Lactic acid	30	30 lactic acid

91	16261	3348	943	4362	3564	3820	Sucrose	45	45 sucrose
92	11867	901	416	1419	715	1359	VC	15	15 VC
93	2689	585	0	857	473	142	L-Ser	15	15 L-Ser
94	10873	4880	747	3373	2094	1373	Maltose	30	30 maltose
95	2190	1746	580	1951	4564	2769	L-Val	15	15 L-Val
96	7029	1673	568	2343	1631	1448	Sucrose	15	15 sucrose
97	10781	6746	3368	10214	1430	2196	L-Phe	30	30 L-Phe
98	3525	739	85	1108	563	154	L-Ser	30	30 L-Ser
99	17156	5427	2284	5031	5258	5248	L-Try	15	15 L-Try
100	10584	3226	756	6392	2370	1419	Glucose	15	15 glucose
101	5884	683	516	975	1283	705	L-Cys-HCl	45	45 L-Cys-HCl
102	24524	7060	1489	11488	3694	3585	Glucose	45	45 glucose
103	11932	1037	298	2225	1242	1805	L-Met	45	45 L-Met
104	6240	632	262	1417	535	1144	L-Met	30	30 L-Met
105	3454	1273	370	1077	1539	1392	L-Lys	30	30 L-Lys
106	4376	466	298	709	804	461	L-Cys-HCl	30	30 L-Cys-HCl
107	6847	3223	562	2201	1821	639	Maltose	15	15 maltose
108	17687	5640	2379	5216	4792	5424	L-Try	15	15 L-Try
109	10839	6965	3042	10070	1498	2130	L-Phe	30	30 L-Phe
110	24232	6961	1370	11665	3457	3277	Glucose	45	45 glucose
111	2715	340	142	841	345	532	L-Met	15	15 L-Met
112	2140	1656	638	2303	4416	3019	L-Val	15	15 L-Val
113	3157	341	313	320	0	2486	Lactic acid	30	30 lactic acid
114	19150	5726	1229	9845	2901	2659	Glucose	30	30 glucose
115	5301	1357	135	1227	942	2897	L-Leu	15	15 L-Leu
116	6420	585	236	1407	646	1221	L-Met	30	30 L-Met
117	12241	2765	739	3456	2820	2680	Sucrose	30	30 sucrose
118	5484	2960	2291	5247	636	1132	L-Phe	15	15 L-Phe
119	25291	9308	3369	7776	9138	9649	L-Try	30	30 L-Try
120	3477	1221	408	1067	1576	1421	L-Lys	30	30 L-Lys
121	12051	919	453	1442	621	1404	VC	15	15 VC
122	12030	2183	600	987	1300	2611	L-Ile	15	15 L-Ile
123	10993	3730	298	2910	1564	9163	L-Leu	45	45 L-Leu
124	16780	4473	703	2291	1969	4849	L-Ile	30	30 L-Ile
125	15991	10377	3526	15109	2325	3515	L-Phe	45	45 L-Phe
126	32569	13947	4748	10854	13384	14352	L-Try	45	45 L-Try

- Here A, B, C, D, E and F represent the six nanoparticles of MgO, ZrO₂, SiO₂, γ -Al₂O₃, Y₂O₃, and SrCO₃ respectively.
- The unit of concentration (C.) is mM.
- The numbers ahead the ID such as 15, 30 and 45 are the concentrations of solutions.
- VC is the abbreviation of ascorbic acid.

Table S4. The original data of CL intensity (a. u.) patterns for eight beverages.

	MgO	ZrO ₂	SiO ₂	γ -Al ₂ O ₃	Y ₂ O ₃	SrCO ₃
Coca-Cola	49103	6366	2741	11864	6563	22024
Coca-Cola	49515	6250	2769	11596	7781	22249
Coca-Cola	48407	6249	2713	12240	6950	22094
Coca-Cola	48691	6343	2760	11668	7007	22754
Coca-Cola	47325	6370	2728	11516	6721	22164
Pepsi-Cola	52761	6393	2302	11096	7713	19371
Pepsi-Cola	51679	6582	2249	11212	6912	17743
Pepsi-Cola	51267	6365	2262	11407	7854	18627
Pepsi-Cola	50671	6293	2368	11060	7467	17813
Pepsi-Cola	49901	6654	2327	11175	6994	18108
Sprite	46655	5727	2047	10031	5744	13967
Sprite	46939	5516	2037	10335	5812	13672
Sprite	46243	5705	2130	10075	5304	13448
Sprite	45702	5511	2183	10147	5082	14416
Sprite	45032	5683	2075	9959	4723	13897
7-up	38257	4993	1809	8200	4585	13083
7-up	40138	5066	1796	7895	4805	11749
7-up	39056	4922	1810	7780	4365	12269
7-up	38515	4943	1744	7743	4374	12104
7-up	39339	4696	1756	7439	3934	12263
Fanta Orange	49232	6578	2248	11606	5856	14685
Fanta Orange	48562	6607	2235	11531	6448	15160
Fanta Orange	48407	6664	2165	11643	6541	15008
Fanta Orange	47995	6388	2199	11568	6039	15221
Fanta Orange	49644	6888	2129	11965	5522	14796
Mirinda Orange	44749	6019	2282	11374	6123	15907
Mirinda Orange	46115	5989	2212	11494	5984	15008
Mirinda Orange	45419	5885	2190	11569	5815	15322
Mirinda Orange	44878	6134	2246	11726	6054	15109
Mirinda Orange	44620	5939	2307	11845	5892	15059
Fanta Apple	46784	7307	2106	12086	5441	13786
Fanta Apple	46527	7057	2081	12198	5276	14473
Fanta Apple	47531	6982	1988	12003	5025	13735
Fanta Apple	47454	7152	1977	12123	5432	13887
Fanta Apple	46656	7122	2021	11808	5449	13735
Mirinda Apple	42044	5485	2152	9672	4814	13719
Mirinda Apple	40807	5739	2047	9754	4774	14098
Mirinda Apple	41915	5210	2104	9829	4880	13787
Mirinda Apple	41220	5375	2058	9634	4853	13836
Mirinda Apple	40807	5236	2105	9597	4587	13563

Table S5. Identification of 24 beverage samples.

#	CL responses patterns (a. u.)						Identification	Verification
	A	B	C	D	E	F		
1	49902	6498	2176	11763	5533	15432	Fanta Orange	Fanta Orange
2	45831	6171	1973	10101	5524	13602	Sprite	Sprite
3	39115	4735	1796	7707	4473	12928	7-up	7-up
4	44337	6188	2293	11771	5786	15008	Mirinda Orange	Mirinda Orange
5	48279	7142	2046	12200	5511	13412	Fanta Apple	Fanta Apple
6	44904	5840	2103	10299	4653	13518	Sprite	Sprite
7	48974	6132	2735	11900	7165	22319	Coca-Cola	Coca-Cola
8	40679	4628	1744	7627	4252	12044	7-up	7-up
9	50056	6088	2315	11291	7004	19216	Pepsi-Cola	Pepsi-Cola
10	51138	6358	2141	12003	6041	14735	Fanta Orange	Fanta Orange
11	50314	6343	2287	11014	6961	17307	Pepsi-Cola	Pepsi-Cola
12	47609	7088	1998	11928	5595	13836	Fanta Apple	Fanta Apple
13	42585	5520	2057	9862	4789	13351	Mirinda Apple	Mirinda Apple
14	41090	5485	2149	9745	4651	13775	Mirinda Apple	Mirinda Apple
15	45573	6152	1996	9807	5317	13013	Sprite	Sprite
16	39339	4893	1753	7518	4180	11300	7-up	7-up
17	46115	6189	2235	11606	6281	14149	Mirinda Orange	Mirinda Orange
18	44620	6274	2307	11532	6057	14735	Mirinda Orange	Mirinda Orange
19	50185	6204	2306	10907	7137	18037	Pepsi-Cola	Pepsi-Cola
20	48561	5965	2729	11784	7623	22459	Coca-Cola	Coca-Cola
21	41632	5351	2160	9791	4611	13249	Mirinda Apple	Mirinda Apple
22	46784	7197	2057	12163	5372	13573	Fanta Apple	Fanta Apple
23	48948	6717	2165	11531	6015	14634	Fanta Orange	Fanta Orange
24	48407	6227	2753	12168	7251	22543	Coca-Cola	Coca-Cola

Table S6. pH values of the analyte solutions (at 30 mM, 25 °C)

pH		pH		pH	
Glucose	6.49	L-Val	6.37	L-Ile	6.05
Sucrose	6.58	L-Try	3.11	L-Leu	6.06
Maltose	6.39	L-Phe	6.02	L-Cys·HCl	0.11
Ascorbic acid	2.82	L-Ser	5.83	L-Met	5.83
Lactic acid	2.52	L-Lys	5.65		

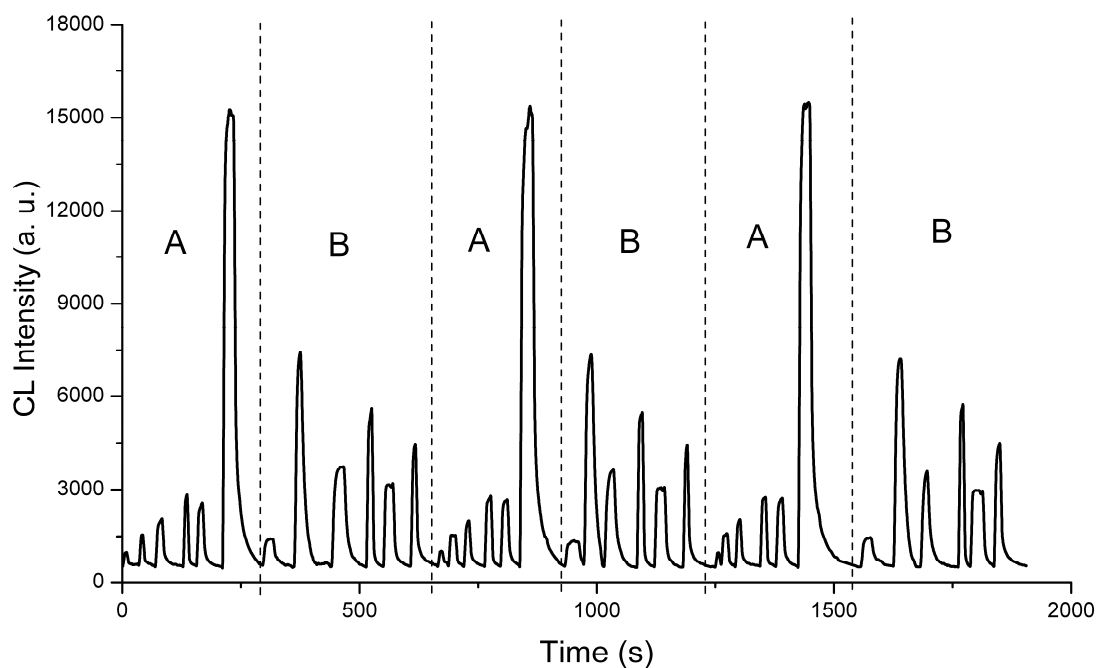


Fig S1. The CL signals in the actual experiment. Six peaks of each sample represent the CL responses on six array elements in the order of SiO_2 , Y_2O_3 , ZrO_2 , SrCO_3 , $\gamma\text{-Al}_2\text{O}_3$, and MgO , respectively. A is ascorbic acid and B is L-Val.

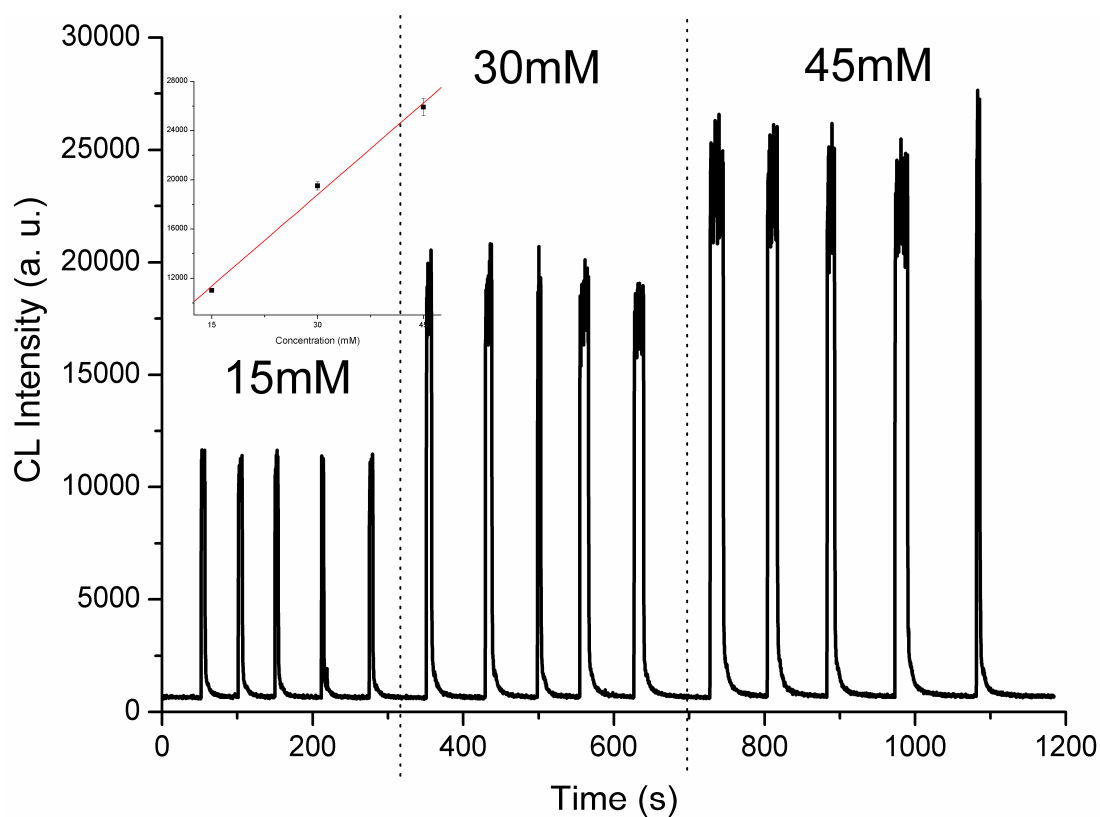


Figure S2. The CL intensities of glucose vary linearly with the increase in concentration from 15 mM to 45 mM.

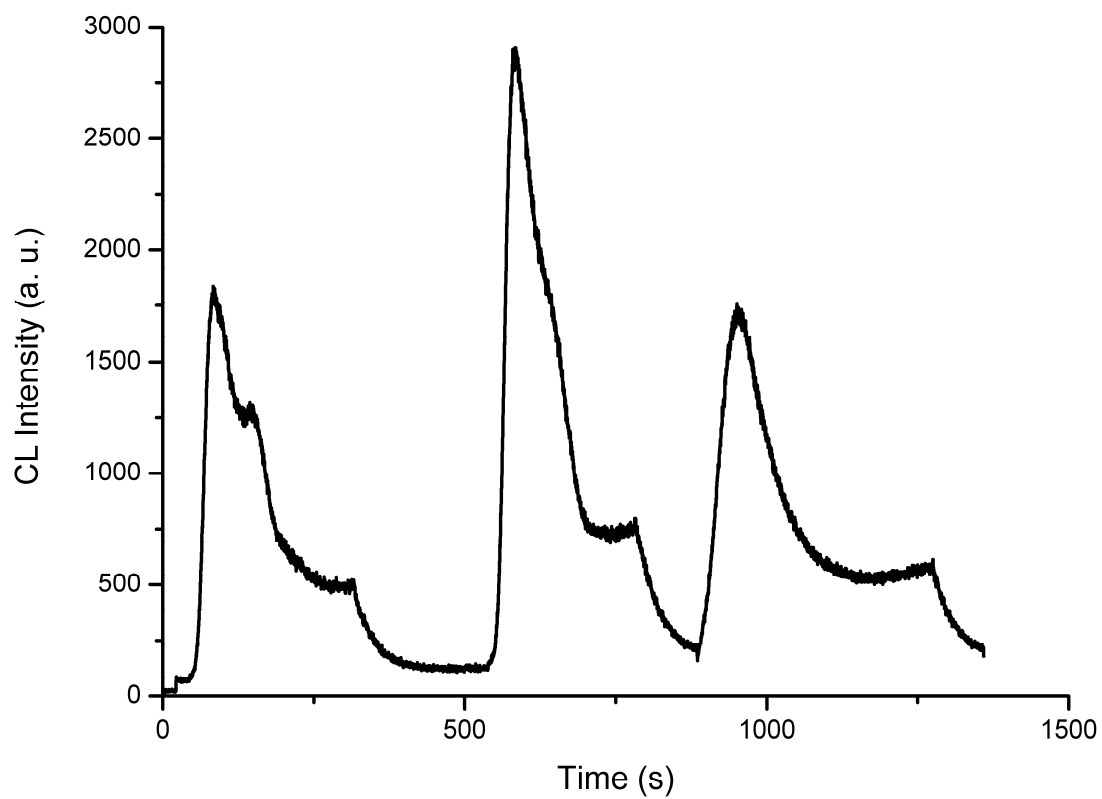


Figure S3. The CL intensity of direct addition of 10 μL sucrose solutions at 100 μM on the surface of MgO for three replicates.