Supplementary Materials

A thermochemiluminescence array for recognition of protein subtypes and their denatured shapes

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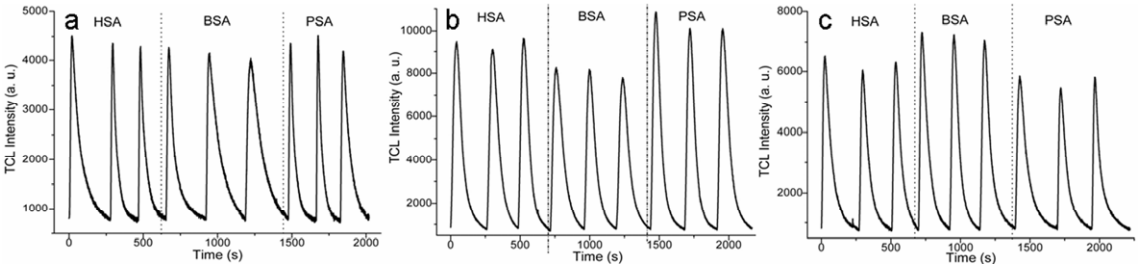

Figure S1. The TCL responses of the three serum albumins (100 μg/mL) on b) ceramic heaters without nanomaterials on it, c) CaO, and d) La_2O_3.

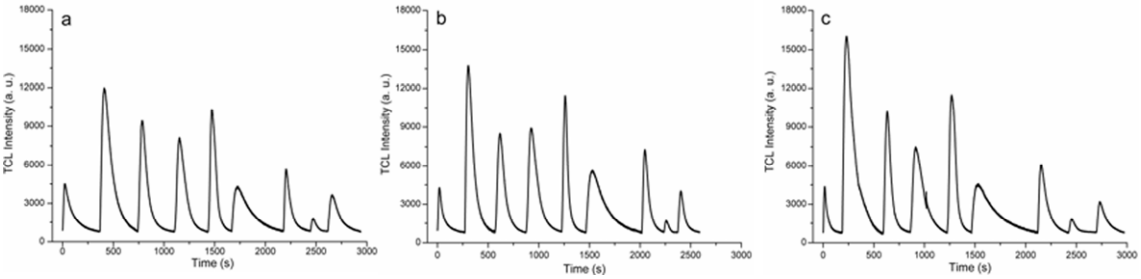

Figure S2. The unique TCL responses patterns generated from three serum albumins (a. HSA, b. BSA and c. PSA) on the nanomaterials array. Nine peaks of each sample represent the TCL responses on array elements in the order of blank, MgO, CaO, SrO, BaO, ZrO_2, La_2O_3, Nd_2O_3, and Dy_2O_3, respectively.

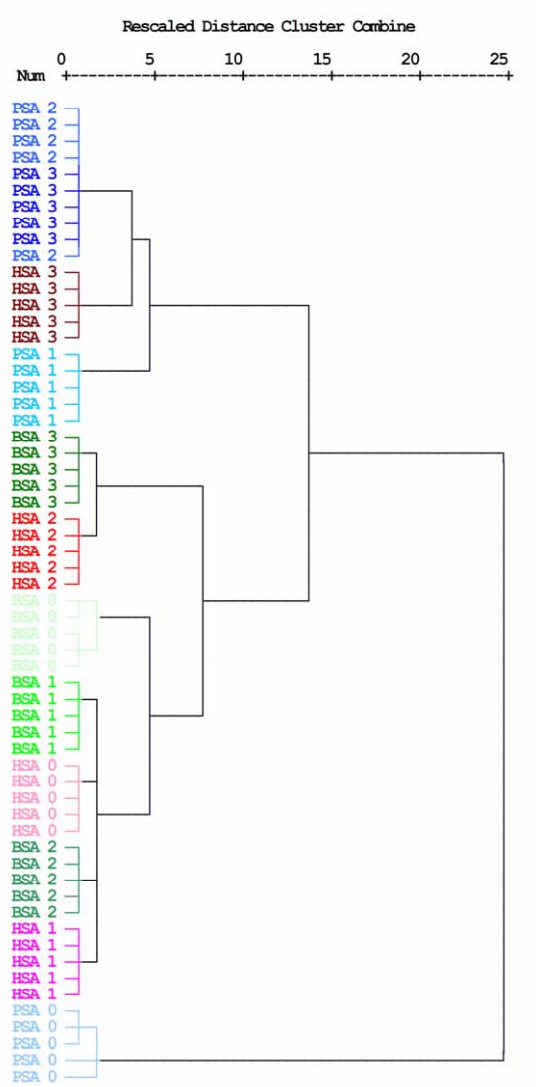

Figure S3. HCA for all the 12 albumin samples. The numbers marked behind the names of serum albumins reperenst the heat conditions in protein denaturation: 0) original serum albumins; 1) heated at 60 °C for 5 min, 2) heated at 60 °C for 10 min; 3) heated at 80 °C for 5 min. Each sample was tested five times.

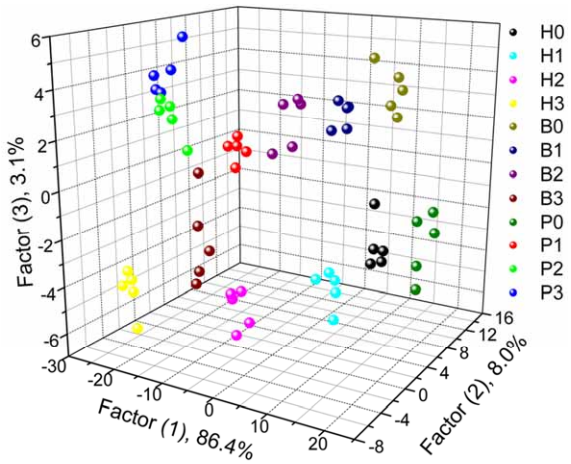

Figure S4. The three-dimensional LDA plot of all the 12 albumin samples described as the caption of Figure S3. Each sample was tested five times.

Table S1. Linear Regression Parameters of serum albumins detection on blank ceramic heaters, nanosized MgO and Bao.

	linear range (μg/mL)	intercept	slope	linear regressiong coefficient	LOD (μg/mL)
HSA on blank	5-100	23	32.81	0.999	3.05
HSA on MgO	2-100	1568	82.29	0.996	1.22
HSA on BaO	2-100	10	93.47	0.996	1.07
BSA on blank	5-100	356	30.09	0.993	3.32
BSA on MgO	2-100	1314	110.15	0.998	0.91
BSA on BaO	2-100	479	99.56	0.997	1.00
PSA on blank	5-100	27	32.57	0.997	3.07
PSA on MgO	2-100	211	146.08	0.995	0.68
PSA on BaO	2-100	179	99.09	0.994	1.01

Table S2. The original data of TCL intensity (a. u.) patterns for 12 serum albumin samples at 100 μg/mL. The numbers marked behind the names of serum albumins reperenst the heat conditions in protein denaturalization: 0) original serum albumins; 1) heated at 60 °C for 5 min, 2) heated at 60 °C for 10 min; 3) heated at 80 °C for 5 min.

	Blank	MgO	CaO	SrO	BaO	ZrO_2	La_2O_3	Nd_2O_3	Dy_2O_3
HSA 0	3548	10928	8555	7007	9504	3521	5174	1070	3141
HSA 0	3690	10473	8268	7216	9991	3605	5659	1083	3202
HSA 0	3327	11297	8726	7253	9874	3842	5558	1132	3018
HSA 0	3470	10569	8333	7318	10077	3763	5688	1059	2955
HSA 0	3518	11083	8426	7034	9787	3891	5260	1047	3247
HSA 1	3523	9085	7771	6829	9801	3688	5445	874	2866
HSA 1	3452	9119	7963	7032	9997	3813	5546	944	2903
HSA 1	3415	9994	7834	6698	9956	3500	5400	956	2925
HSA 1	3241	10052	8102	6752	10217	3954	5675	935	2883
HSA 1	3361	9465	8080	6907	10040	3483	5518	941	2819
HSA 2	3076	9250	7012	5321	8954	4116	5041	852	2128
HSA 2	3289	9449	6696	5520	8856	4030	5060	967	1967
HSA 2	3365	8922	7250	5186	8621	3799	4878	873	2042
HSA 2	3154	8776	6884	5636	8547	3959	5071	884	2237
HSA 2	3048	8863	7393	5335	8752	3893	4936	989	2340
HSA 3	3075	8296	6436	3135	7278	4558	3831	627	1445
HSA 3	3263	9449	6217	3321	6926	4433	4005	589	1241
HSA 3	3187	8662	6529	3096	7165	4385	4002	738	1176
HSA 3	2964	9040	6020	3396	7394	4221	3789	690	1287
HSA 3	2893	8778	6450	3457	7489	4660	3916	616	1334
BSA 0	3335	13000	8183	7930	10705	4945	6386	883	3255
BSA 0	3540	11803	7629	8139	10621	4632	6425	1032	3173
BSA 0	3537	12406	7398	7317	11244	4570	5901	958	3311
BSA 0	3647	12831	7664	7251	11025	4881	6047	945	3418
BSA 0	3451	11665	7430	7540	10266	4822	5978	960	3504
BSA 1	3585	10936	7181	7017	9228	4154	5453	889	3213
BSA 1	3469	11012	7424	7378	9059	4096	5392	925	3421
BSA 1	3668	10857	7558	7158	9593	4217	5224	892	3333
BSA 1	3517	11072	7236	6971	9374	3978	5364	920	3518
BSA 1	3490	10877	7395	6943	9643	4356	5252	893	3376
BSA 2	3521	9687	6530	6827	9781	4279	4993	772	2924
BSA 2	3390	9552	6747	6420	9652	4500	5259	827	2755
BSA 2	3428	10136	6893	6712	9602	4483	5021	928	2971
BSA 2	3219	9964	6883	6930	10051	4321	4821	839	2998
BSA 2	3354	10321	6951	6556	9893	4260	4971	799	2783
BSA 3	2880	7967	6709	5951	8280	3857	4719	786	2008
BSA 3	2917	8327	6633	6083	8572	3737	4490	757	2196
BSA 3	3024	8257	6518	5820	8188	3747	4543	796	2017
BSA 3	2984	8146	6201	6079	8641	4290	4480	828	2238
BSA 3	2832	8082	6317	6181	8693	4084	4617	835	2044
PSA 0	3575	15135	9452	6673	9586	3657	5236	1254	2487
PSA 0	3630	15994	9018	6456	10647	4013	5153	1336	2673
PSA 0	3417	16537	8963	6354	10883	3842	5364	1207	2790
PSA 0	3451	14794	9216	6270	11012	3530	5046	1193	2541
PSA 0	3320	15539	8846	6534	10331	4028	5270	1314	2632
PSA 1	3002	11398	6120	4662	8844	4787	3970	1029	1819
PSA 1	3110	11118	6294	4774	8625	4469	3942	1034	1951
PSA 1	3258	10936	6367	4532	9015	4988	3987	1085	1987
PSA 1	2906	11123	6716	4688	8548	4852	3939	1058	2080

PSA 1	2839	11454	6804	4856	8736	4699	3795	1079	1978
PSA 2	3103	10149	6258	3178	7608	5369	2884	850	1706
PSA 2	3217	9815	6584	3246	7813	5479	3018	878	1763
PSA 2	3026	10079	5918	3306	7905	5266	2976	901	1595
PSA 2	3146	10847	6499	3154	7767	5155	3067	997	1506
PSA 2	3232	10032	6255	3098	7678	5167	2913	928	1819
PSA 3	2870	9770	6196	3521	7339	5735	3042	1061	1418
PSA 3	2684	10668	6217	3397	7430	5605	3221	921	1678
PSA 3	3021	11321	6328	3648	7281	5978	3142	1051	1596
PSA 3	2995	11451	6530	3236	7538	5829	3288	773	1726
PSA 3	2575	10983	6401	3197	7153	5698	3017	828	1735

Table S3. Secondary structures of serum albumins and denatured albumins. The numbers marked behind the names of serum albumins reperenst the heat conditions in protein denaturalization: 0) original serum albumins; 1) heated at 60 °C for 5 min, 2) heated at 60 °C for 10 min; 3) heated at 80 °C for 5 min.

	α %	β %	Turn %	Random %
HSA 0	29.0	21.0	18.7	31.3
HSA 1	29.2	18.8	20.3	31.7
HSA 2	29.7	19.1	19.5	31.8
HSA 3[a]	38.8	0.0	29.1	32.1
BSA 0	33.1	16.8	19.1	31.0
BSA 1	28.9	21.0	15.9	29.9
BSA 2	28.9	16.3	22.4	32.4
BSA 3	33.3	18.2	17.7	30.8
PSA 0	34.6	17.9	18.0	29.5
PSA 1	51.3	0.0	26.6	22.3
PSA 2	63.1	0.0	25.2	11.7
PSA 3	70.1	0.0	27.3	2.6

a. The calculations of the secondary structure of HSA 3, PSA 1, PSA 2 and PSA 3 diverge from the theoretical modelling and are just for reference.

Table S4. Identification of 24 unknown albumin samples.

#	TCL intensity patterns (a. u.)									Identification	Verification
	1	2	3	4	5	6	7	8	9[a]		
1	3169	9963	6021	3196	7654	5399	3030	963	1632	PSA 2	PSA 2
2	3321	9312	7101	5496	8931	3813	4735	841	2163	HSA 2	HSA 2
3	3520	11921	7632	8013	10987	4953	6245	983	3423	BSA 0	BSA 0
4	3286	9236	8097	6931	9865	3732	5531	933	2863	HSA 1	HSA 1
5	2901	10233	6214	3314	7364	5642	3210	821	1563	PSA 3	PSA 3
6	3430	9836	6632	6632	9854	4231	5063	712	2863	BSA 2	BSA 2
7	3632	10932	7396	6243	9142	4101	5321	944	3256	BSA 1	BSA 1
8	2931	8321	6821	6151	8321	4196	4835	821	2045	BSA 3	BSA 3
9	3466	11101	8470	7213	9681	3941	5763	1036	3078	HSA 0	HSA 0
10	3596	10032	7032	6521	9931	4432	4941	930	2910	BSA 2	BSA 2
11	2896	8021	6465	5921	8446	3837	4534	773	2235	BSA 3	BSA 3
12	3073	11432	5931	4732	8732	4632	3854	1032	1824	PSA 1	PSA 1
13	3456	15321	8923	6635	10321	3942	5320	1268	2496	PSA 0	PSA 0
14	3095	8931	6521	3396	4365	4484	4212	741	1123	HSA 3	HSA 3
15	3178	8930	6932	5421	8821	4032	5142	865	1949	HSA 2	HSA 2
16	2851	11065	6348	3496	7165	5738	3324	809	1477	PSA 3	PSA 3
17	3396	9352	7931	6732	9756	3332	5453	896	2931	HSA 1	HSA 1
18	3510	15656	9124	6523	10771	4014	5012	1301	2647	PSA 0	PSA 0
19	3217	10321	6321	3214	7712	5321	2917	832	1731	PSA 2	PSA 2
20	3687	10831	8532	7342	9846	3782	5479	1096	3158	HSA 0	HSA 0
21	3517	10896	7232	6132	9463	4031	5421	953	3314	BSA 1	BSA 1
22	3439	12304	7723	7423	10352	4786	6132	971	3393	BSA 0	BSA 0
23	3123	8211	6146	3263	4231	4632	4112	631	1431	HSA 3	HSA 3
24	3121	11321	6231	4569	8863	4314	3741	1063	2064	PSA 1	PSA 1

a. Here 1, 2 to 9 represent the nine sensing elements of blank, MgO, CaO, SrO, BaO, ZrO_2, La_2O_3, Nd_2O_3, and Dy_2O_3, respectively.