

Electronic Supplementary Information

**Development of Spike Protein-based Fluorescence Lateral Flow
Assay for the Simultaneous Detection of SARS-CoV-2 Specific IgM
and IgG**

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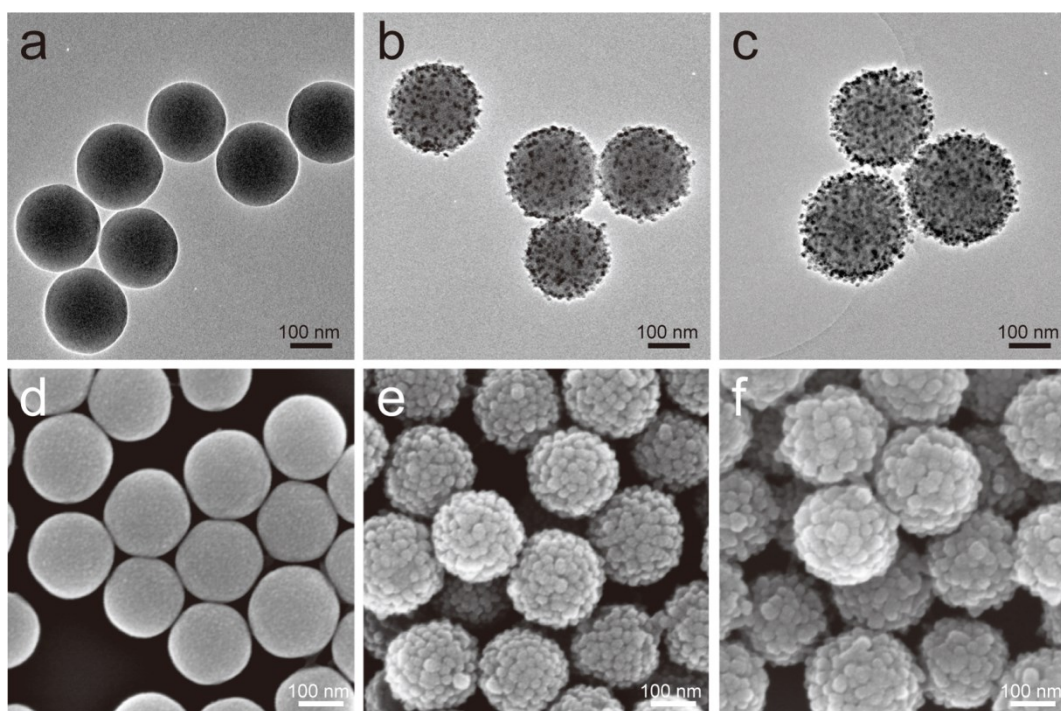
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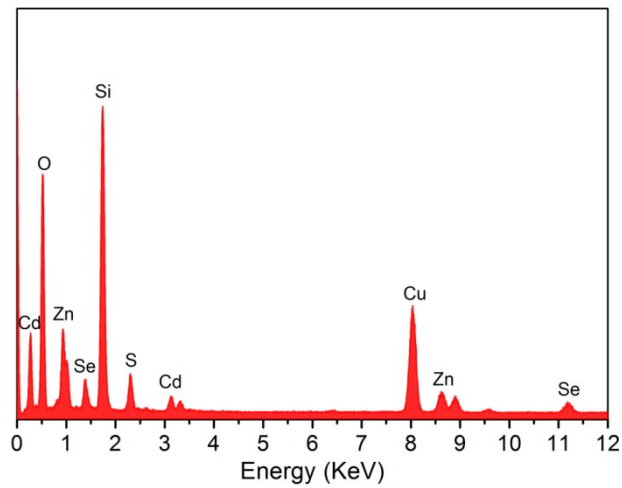
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1
2 **Fig. S1** TEM images of (a) SiO₂, (b) SiO₂@QD, and (c) SiO₂@DQD NBs, and their
3 corresponding SEM images (d), (e), and (f), respectively.
4



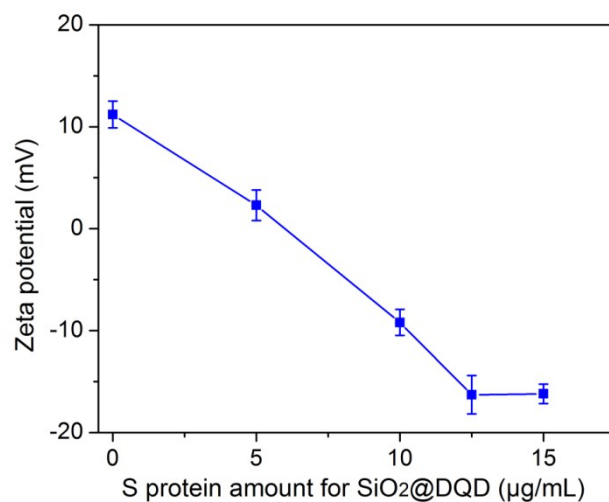
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2 **Fig. S2** EDS spectrum of a single SiO₂@DQD NB. The Cu signal is from the Cu grids of the
3 TEM sample.

4

1 **S1. Modification of S proteins onto the surface of SiO₂@DQD NBs**

2 SiO₂@DQD NBs were conjugated with S protein via carbodiimine chemistry. Saturated S
3 protein was used to the effectiveness and stability of SiO₂@DQD-S protein labels. The zeta
4 potential values of SiO₂@DQD decreased with increasing antigen amount (5–12.5 µg) and
5 remained stable at –16.2 mV, indicating the saturated loading of the S protein (Fig. S3).



6
7 **Fig. S3** Zeta potential of SiO₂@DQD versus the amount of S protein modified on their surface.
8 The error bars represent the standard deviations from three measurements.

9



1
2 **Fig. S4** Photographs of commercial colloidal gold strips for a positive SARS-CoV-2 serum
3 specimen with different dilutions.
4

1

2 Table S1. Clinical sample analysis results.

Sample No.	Clinical diagnosis	Infection course (day)	IgM test intensity (a.u.)	IgG test intensity (a.u.)	Interpretation result		
					IgM	IgG	IgM&IgG
1	P++	8	335	0	P	N	P
2	P++	3	251	0	P	N	P
3	P++	5	338	0	P	N	P
4	P++	5	248	0	P	N	P
5	P++	6	338	3	P	N	P
6	P++	1	251	0	P	N	P
7	P++	4	74	0	P	N	P
8	P++++	21	3040	489	P	P	P
9	P+++	13	960	947	P	P	P
10	P++++	22	3346	489	P	P	P
11	P++++	10	335	0	P	N	P
12	P+	9	4357	1942	P	P	P
13	P++	32	654	857	P	P	P
14	P+++	39	1594	547	P	P	P
15	P++	13	184	26	P	N	P
16	P++	21	3323	853	P	P	P
17	P++	18	428	979	P	P	P
18	P++	14	1079	457	P	P	P
19	P++	17	380	126	P	P	P
20	P++	27	5052	544	P	P	P
21	P+++	21	2322	1652	P	P	P
22	P	5	213	19	P	N	P
23	P	11	351	222	P	P	P
24	P++	22	2727	657	P	P	P
25	P++	14	345	232	P	P	P
26	P++	2	486	177	P	P	P
27	P++	14	770	254	P	P	P
28	P++	36	406	615	P	P	P
29	P++	13	541	531	P	P	P
30	P	34	219	26	P	N	P
31	P	34	235	132	P	P	P
32	P++	18	576	1304	P	P	P
33	P+	13	251	799	P	P	P
34	P++	20	270	1059	P	P	P
35	P++	23	1085	473	P	P	P
36	P++	18	180	348	P	P	P
37	P++	12	1530	1224	P	P	P
38	P++	6	261	348	P	P	P
39	P++	14	956	277	P	P	P
40	P++	24	341	667	P	P	P

41	P++	19	528	1117	P	P	P
42	P	14	132	702	P	P	P
43	P++	14	557	161	P	P	P
44	P	35	196	174	P	P	P
45	P++	19	251	667	P	P	P
46	P++	9	229	74	P	P	P
47	P++	22	2257	599	P	P	P
48	P	1	89	1773	P	P	P
49	P++	22	245	509	P	P	P
50	P++	1	90	557	P	P	P
51	P	0	37	25	N	N	N
52	P++	22	670	860	P	P	P
53	P++	20	254	1275	P	P	P
54	P++	22	396	1262	P	P	P
55	P	18	222	644	P	P	P
56	P++	21	264	654	P	P	P
57	P++	23	264	660	P	P	P
58	P++	29	232	74	P	P	P
59	P++	23	422	544	P	P	P
60	P	8	731	67	P	P	P
61	P++	22	3310	2106	P	P	P
62	P++	24	799	193	P	P	P
63	P++	35	3906	438	P	P	P
64	P++	20	535	113	P	P	P
65	P++	19	808	200	P	P	P
66	P++	27	428	853	P	P	P
67	P++	5	165	171	P	P	P
68	P	6	2	53	N	P	P
69	P++	0	176	7	P	N	P
70	P++	13	213	250	P	P	P
71	P	4	25	39	N	P	P
72	P	14	275	177	P	P	P
73	P	0	76	327	P	P	P
74	P	14	73	312	P	P	P
75	P+	9	249	316	P	P	P
76	P	0	276	54	P	P	P
77	P++	2	199	285	P	P	P
78	P	2	77	4	P	N	P
79	P++	2	187	42	P	P	P
80	P++	2	259	180	P	P	P
81	P++	7	184	36	P	P	P
82	P++	2	219	15	P	P	P
83	P++	1	251	23	P	P	P
84	P++	1	25	5	N	N	N

85	P	1	28	16	N	N	N
86	P	2	226	6	P	N	P
87	P	1	183	169	P	P	P
88	P	0	23	65	N	P	P
89	P	12	215	331	P	P	P
90	P	1	188	321	P	P	P
91	P	2	206	252	P	P	P
92	P	1	145	53	P	P	P
93	P++	14	262	68	P	P	P
94	P++	14	150	241	P	P	P
95	P	14	349	306	P	P	P
96	P++	14	186	130	P	P	P
97	P++	14	235	238	P	P	P
98	P	9	338	200	P	P	P
99	P	14	241	90	P	P	P
100	P	4	11	86	N	P	P
101	P++	14	45	142	N	P	P
102	P	1	245	168	P	P	P
103	P	1	228	41	P	P	P
104	P	1	147	132	P	P	P
105	P	1	130	273	P	P	P
106	P	8	168	303	P	P	P
107	P++	12	155	201	P	P	P
108	P+++	36	2170	908	P	P	P
109	P++	12	277	660	P	P	P
110	P++	17	2074	1108	P	P	P
111	P++	10	679	409	P	P	P
112	P++++	11	1159	193	P	P	P
113	P++	8	509	77	P	P	P
114	P+++	17	676	415	P	P	P
115	N (fever)	2	0	0	N	N	N
116	N (fever)	2	48	0	N	N	N
117	N (fever)	2	0	0	N	N	N
118	N (fever)	1	0	35	N	N	N
119	N (fever)	1	0	0	N	N	N
120	N (fever)	1	0	0	N	N	N
121	N (fever)	1	0	0	N	N	N
122	N (fever)	1	0	0	N	N	N
123	N (fever)	1	3	23	N	N	N
124	N (fever)	1	6	29	N	N	N
125	N (fever)	1	6	23	N	N	N
126	N (fever)	1	39	0	N	N	N
127	N (fever)	1	0	0	N	N	N
128	N (fever)	1	0	0	N	N	N

129	N (fever)	1	0	35	N	N	N
130	N (fever)	1	42	0	N	N	N
131	N (fever)	1	39	0	N	N	N
132	N (fever)	1	0	0	N	N	N
133	N (fever)	1	0	0	N	N	N
134	N (fever)	1	16	29	N	N	N
135	N (fever)	1	0	0	N	N	N
136	N (fever)	1	32	0	N	N	N
137	N (fever)	1	0	0	N	N	N
138	N (fever)	1	0	0	N	N	N
139	N (fever)	1	0	0	N	N	N
140	N (fever)	4	3	32	N	N	N
141	N (fever)	4	42	0	N	N	N
142	N (fever)	1	13	0	N	N	N
143	N (fever)	1	0	0	N	N	N
144	N (fever)	3	0	0	N	N	N
145	N (fever)	1	0	0	N	N	N
146	N (fever)	2	6	0	N	N	N
147	N (fever)	1	16	26	N	N	N
148	N (fever)	2	0	0	N	N	N
149	N (fever)	1	0	0	N	N	N
150	N (fever)	1	0	0	N	N	N
151	N (fever)	1	0	0	N	N	N
152	N (fever)	3	0	0	N	N	N
153	N (fever)	1	48	0	N	N	N
154	N (fever)	3	45	0	N	N	N
155	N (fever)	3	42	0	N	N	N
156	N (fever)	1	42	0	N	N	N
157	N (fever)	1	0	0	N	N	N
158	N (fever)	1	0	0	N	N	N
159	N (fever)	1	16	0	N	N	N
160	N (fever)	1	13	0	N	N	N
161	N (fever)	1	9	7	N	N	N
162	N (fever)	1	6	2	N	N	N
163	N (fever)	1	9	1	N	N	N
164	N (fever)	1	6	5	N	N	N
165	N (fever)	1	9	3	N	N	N
166	N (fever)	1	6	0	N	N	N
167	N (fever)	1	5	10	N	N	N
168	N (fever)	1	3	10	N	N	N
169	N (fever)	1	8	6	N	N	N
170	N (fever)	1	5	0	N	N	N
171	N (fever)	1	6	4	N	N	N
172	N (fever)	1	6	7	N	N	N

173	N (fever)	1	5	0	N	N	N
174	N (fever)	1	5	10	N	N	N
175	N (fever)	1	0	1	N	N	N
176	N (fever)	3	2	5	N	N	N
177	N (fever)	3	9	9	N	N	N
178	N (fever)	3	5	7	N	N	N
179	N (fever)	3	6	8	N	N	N
180	N (fever)	3	10	1	N	N	N
181	N (fever)	3	9	8	N	N	N
182	N (fever)	3	200	10	P	N	P
183	N (fever)	2	4	2	N	N	N
184	N (fever)	2	0	8	N	N	N
185	N (fever)	2	4	9	N	N	N
186	N (fever)	2	4	6	N	N	N
187	N (fever)	7	2	0	N	N	N
188	N (fever)	2	7	5	N	N	N
189	N (fever)	2	7	1	N	N	N
190	N (fever)	2	2	2	N	N	N
191	N (fever)	2	3	2	N	N	N
192	N (fever)	1	0	9	N	N	N
193	N (fever)	1	10	2	N	N	N
194	N (fever)	2	3	4	N	N	N
195	N (fever)	1	1	3	N	N	N
196	N (fever)	4	6	3	N	N	N
197	N (fever)	1	4	0	N	N	N
198	N (fever)	3	1	0	N	N	N
199	N (fever)	4	4	5	N	N	N
200	N (fever)	3	10	10	N	N	N
201	N (fever)	3	8	4	N	N	N
202	N (fever)	2	8	7	N	N	N
203	N (fever)	3	5	6	N	N	N
204	N (fever)	2	6	8	N	N	N
205	N (fever)	1	16	0	N	N	N
206	N (fever)	3	0	16	N	N	N
207	N (fever)	1	48	0	N	N	N
208	N (fever)	1	6	0	N	N	N
209	N (fever)	2	0	19	N	N	N
210	N (fever)	2	48	0	N	N	N
211	N (fever)	2	19	0	N	N	N
212	N (fever)	1	0	0	N	N	N
213	N (fever)	2	48	0	N	N	N
214	N (fever)	1	26	0	N	N	N
215	N (fever)	2	39	3	N	N	N
216	N (fever)	1	45	0	N	N	N

217	N (fever)	1	45	0	N	N	N
218	N (fever)	4	0	3	N	N	N
219	N (fever)	1	0	10	N	N	N
220	N (fever)	3	23	81	N	P	P
221	N (fever)	1	0	10	N	N	N
222	N (fever)	1	0	0	N	N	N
223	N (fever)	2	32	0	N	N	N
224	N (fever)	1	32	0	N	N	N
225	N (fever)	1	6	0	N	N	N
226	N (fever)	1	0	0	N	N	N
227	N (fever)	1	0	13	N	N	N
228	N (fever)	2	0	0	N	N	N
229	N (fever)	3	0	0	N	N	N
230	N (fever)	2	0	61	N	P	P
231	N (fever)	0	0	39	N	P	P
232	N (fever)	2	48	0	N	N	N
233	N (fever)	1	0	0	N	N	N
234	N (fever)	1	0	0	N	N	N
235	N (fever)	1	0	0	N	N	N
236	N (fever)	1	0	6	N	N	N
237	N (fever)	1	23	0	N	N	N
238	N (fever)	1	0	0	N	N	N
239	N (fever)	1	0	42	N	P	P
240	N (fever)	1	0	0	N	N	N
241	N (fever)	1	0	0	N	N	N
242	N (fever)	1	32	0	N	N	N
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244	N (fever)	1	32	0	N	N	N
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246	N (fever)	1	0	0	N	N	N
247	N (fever)	1	0	0	N	N	N
248	N (fever)	1	13	0	N	N	N
249	N (fever)	1	0	0	N	N	N
250	N (fever)	1	16	0	N	N	N
251	N (fever)	1	0	19	N	N	N
252	N (fever)	1	0	0	N	N	N
253	N (fever)	1	0	0	N	N	N
254	N (fever)	1	48	0	N	N	N
255	N (fever)	1	0	19	N	N	N
256	N (fever)	1	16	0	N	N	N
257	N (fever)	1	0	0	N	N	N
258	N (fever)	1	0	0	N	N	N
259	N (fever)	1	39	0	N	N	N
260	N (fever)	1	39	0	N	N	N

261	N (fever)	1	42	0	N	N	N
262	N (fever)	1	35	0	N	N	N
263	N (fever)	1	39	0	N	N	N
264	N (fever)	1	39	0	N	N	N
265	N (fever)	1	42	0	N	N	N
266	N (fever)	1	48	0	N	N	N
267	N (fever)	1	45	0	N	N	N
268	N (fever)	1	0	0	N	N	N
269	N (fever)	1	26	0	N	N	N
270	N (fever)	1	29	0	N	N	N
271	N (fever)	1	0	0	N	N	N
272	N (fever)	1	0	0	N	N	N
273	N (fever)	1	45	0	N	N	N
274	N (fever)	2	32	0	N	N	N
275	N (fever)	2	32	0	N	N	N
276	N (fever)	1	39	0	N	N	N
277	N (fever)	1	0	0	N	N	N
278	N (fever)	1	0	0	N	N	N
279	N (fever)	1	45	52	N	P	P
280	N (fever)	1	32	0	N	N	N
281	N (fever)	1	0	0	N	N	N
282	N (fever)	1	0	0	N	N	N
283	N (fever)	1	0	0	N	N	N
284	N (fever)	2	0	0	N	N	N
285	N (fever)	2	32	81	N	P	P
286	N (fever)	0	26	93	N	P	P
287	N (fever)	1	39	0	N	N	N
288	N (fever)	1	45	0	N	N	N
289	N (fever)	2	32	6	N	N	N
290	N (fever)	3	39	13	N	N	N
291	N (fever)	2	39	13	N	N	N
292	N (fever)	2	39	16	N	N	N
293	N (fever)	2	48	23	N	N	N
294	N (fever)	2	0	0	N	N	N
295	N (fever)	1	0	0	N	N	N
296	N (fever)	2	0	6	N	N	N
297	N (fever)	1	0	0	N	N	N
298	N (fever)	2	29	0	N	N	N
299	N (fever)	1	48	26	N	N	N
300	N (fever)	2	19	32	N	N	N
301	N (fever)	2	0	0	N	N	N
302	N (fever)	2	0	26	N	N	N
303	N (fever)	1	0	0	N	N	N
304	N (fever)	1	0	0	N	N	N

305	N (fever)	1	0	10	N	N	N
306	N (fever)	1	48	0	N	N	N
307	N (fever)	2	6	0	N	N	N
308	N (fever)	1	0	77	N	P	P
309	N (fever)	3	0	35	N	N	N
310	N (fever)	2	0	35	N	N	N
311	N (fever)	2	0	0	N	N	N
312	N (fever)	1	0	0	N	N	N
313	N (fever)	1	0	0	N	N	N
314	N (fever)	2	0	0	N	N	N
315	N (fever)	1	0	0	N	N	N
316	N (fever)	2	0	0	N	N	N

1 P, asymptomatic infected; P+, infected with mild symptoms; P++, infected with moderate
2 symptoms; P+++, infected with severe symptoms; P++++, infected with critical symptoms; N,
3 negative case.
4