Titanium Cells Thickness Memo

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File: Ti cell thickness memo

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Technique

The sample thickness of 1 mm, 2 mm and 4 mm thick Ti cells were determined by measuring the transmission from de-ionized water. Note the samples were not degassed and some small bubbles were seen on the glass surfaces. All large bubbles were removed. Measurements were made on four separate occasions on both NG7 and NGB 30m SANS instruments using λ = 6 Å, eight guides and sample detector distance of at least 13 m distance to enlarge beam area to allow higher count rates. The thickness was determined using the expression:

$$d_s = -\ln(T) / \Sigma_{total}$$

where Σ_{tot} = 6.539 cm^{-1} from water at 20° C and λ = 6 Å based upon an ILL report. Note that if the wavelength differs from nominal value a significant systematic error is created by using an incorrect value for Σ_{tot}. The typical standard error from counting statistics is 0.003 mm.

Results

• 1 mm thick cells having ID 1-20 had a measured thickness of 0.97 mm +/- 0.01 mm.

• 1 mm thick cells having ID 50-100 had an average thickness near 1 mm, but varied over a larger range spanning 0.9 to 1.06 mm.

• 2 mm thick cells having ID 50-90 had an average thickness near 1.98 mm, but varied over a large range spanning 1.91 to 2.05 mm. One cell (#63) was unusually

thin at 1.73 mm (verified with mechanical caliper measurement). This cell should be removed from use.

• 4 mm thick cells having ID 15-35 had an average thickness near 3.94 mm, but varied over a large range spanning 3.82 to 4.01 mm.

• Seven 1-mm cells were measured twice: Jan 5th and on May 26th. The repeat cell IDs are: 133, 135-138 and 141.

• 20 more 1-mm cells were measured on Sep 14th, 2015.

• New USANS cells were measured on Sep 14th, 2015. Cells #1-10 of both 2 mm and 5 mm path length.

• New 1-mm cells having ID's 161 – 261 were measured Oct 16th, 2015.

• New 2-mm cells having green values were measured in June, 2019.

• 80 New 1-mm cells having red values were measured Jan 5th, 2020.

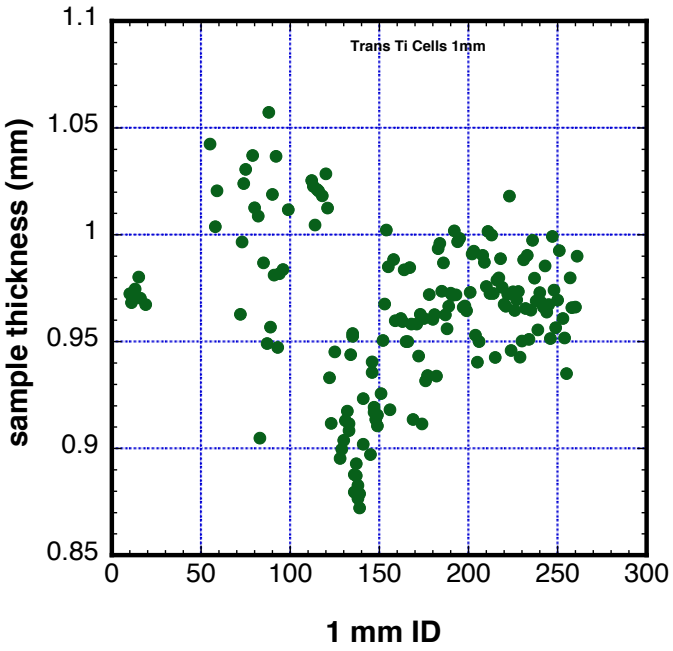

Figure 1. Sample thickness determined from transmission from water for nominally 1 mm thick Ti cells. Note that the measured thickness of cells having ID 1-20 are rather uniform while higher ID numbers are more scattered. ID 1-20 were manufactured separately.

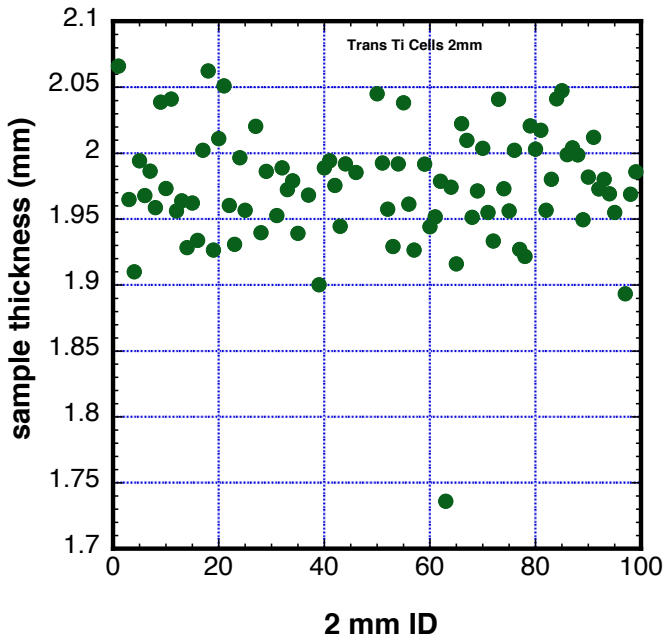

Figure 2. Sample thickness determined from transmission from water for nominally 2 mm thick Ti cells.

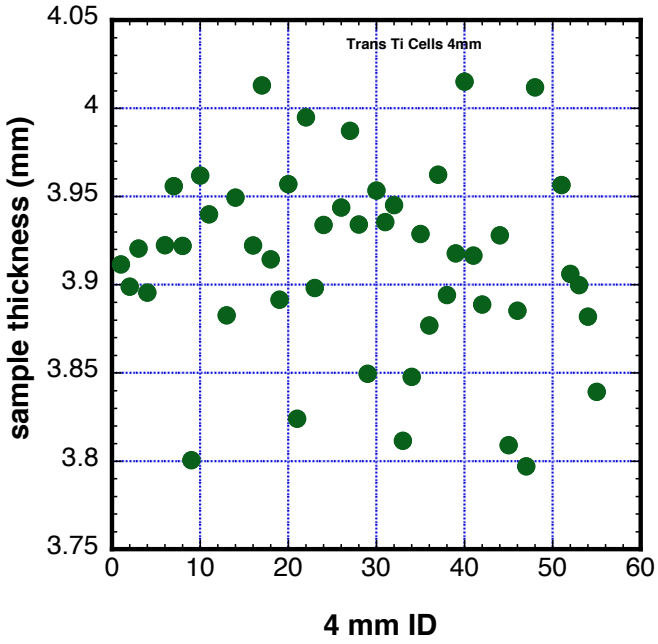

Figure 3. Sample thickness determined from transmission from water for nominally 4 mm thick Ti cells.

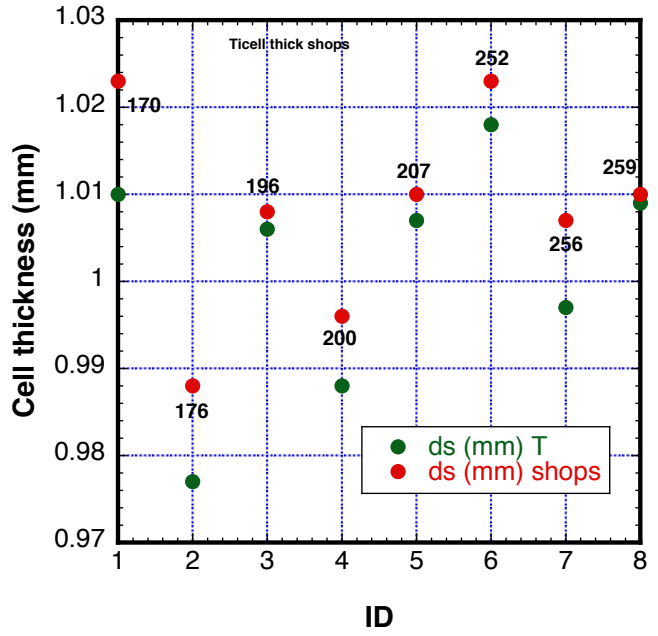

Figure 4. Comparison of thickness of eight 1 mm thick cells measured both by shops and by water transmission. Shop measured thicknesses are all slightly larger than that found by neutron transmission from water. The cell ID number is included in graph.

Table 1. Measured transmission of water and calculated sample thickness for SANS cells. Measurements in green and red of new cells were made in June 2019 and Jan, 2020.

	1 mm			**2 mm**			**4 mm**	
I.D.#	T	d_s (mm)	I.D.#	T	d_s (mm)	I.D.#	T	d_s (mm)
1	0.520	0.985	1	0.259	2.066	1	0.0775	3.911
2	0.521	1.016	2		2.073	2	0.0781	3.899
3	0.526	0.983	3	0.271	1.965	3	0.0770	3.921
4		1.015	4	0.287	1.910	4	0.0783	3.896
5	0.525	0.968	5	0.271	1.994, 2.071[n]	5		
6	0.517	0.971	6	0.276	1.968	6	0.0769	3.922
7			7	0.273	1.986	7	0.0753	3.956
8	0.517	0.993	8	0.278	1.959	8	0.0770	3.922
9		1.010	9	0.264	2.039	9	0.0833	3.801
10	0.529	0.972	10	0.270	1.973	10	0.0750	3.962
11	0.531	0.968	11	0.258	2.041	11	0.0761	3.940
12	0.523	0.977	12	0.273	1.956	12		
13	0.529	0.975	13	0.272	1.964	13	0.0790	3.883
14		1.017	14	0.278	1.928	14	0.0756	3.949
15	0.527	0.980	15	0.272	1.962	15		
16	0.530	0.970	16	0.277	1.934	16	0.0769	3.922
17			17	0.265	2.002	17	0.0725	4.013
18			18	0.254	2.062	18	0.0773	3.914
19	0.531	0.967	19	0.278	1.926	19	0.0785	3.891
20		1.010	20	0.263	2.011	20	0.0752	3.957
21	0.561	0.872	21	0.256	2.051	21	0.0820	3.824
22	0.507	1.040	22	0.272	1.960	22	0.0734	3.995
23			23	0.278	1.931	23	0.0782	3.898

24			24	0.266	1.997	24	0.0764	3.934
25	0.517	1.010	25	0.273	1.957	25		
26	0.500	1.044	26		2.088	26	0.0759	3.944
27	0.524	0.990	27	0.262	2.020	27	0.0737	3.987
28	0.510	1.029	28	0.276	1.940	28	0.0763	3.934
29	0.523	0.975	29	0.268	1.986	29	0.0807	3.850
30		1.007	30			30	0.0754	3.953
31	0.542	0.921	31	0.279	1.953	31	0.0763	3.936
32	0.524	0.975, 1.002[n]	32	0.272	1.989	32	0.0758	3.945
33	0.525	0.971	33	0.275	1.972	33	0.0827	3.812
34	0.507	1.022	34	0.274	1.979	34	0.0808	3.848
35		1.007	35	0.281	1.939	35	0.0766	3.929
36		1.024	36		2.090	36	0.0793	3.877
37	0.512	1.023, 1.020[n]	37	0.276	1.968	37	0.0749	3.962
38	0.505	1.030	38			38	0.0784	3.894
39	0.531	0.955	39	0.289	1.900	39	0.0772	3.918
40	0.537	0.951	40	0.267	1.989	40	0.0724	4.015
41	0.505	1.030	41	0.266	1.994	41	0.0772	3.917
42	0.508	1.020	42	0.269	1.976	42	0.0757	3.889
43		1.007	43	0.275	1.944	43		
44			44	0.267	1.992	44	0.0766	3.928
45	0.501	1.042	45		2.021	45	0.0828	3.809
46	0.512	1.010	46	0.268	1.985	46	0.0788	3.885
47	0.531	0.969	47			47	0.0804	3.797
48	0.503	1.052	48			48	0.0726	4.012
49			49			49		
50		1.021	50	0.257	2.045	50		
51		1.006	51	0.266	1.992	51	0.0752	3.957

52		1.005	52	0.273	1.958	52	0.0778	3.906
53		1.006	53	0.283	1.929	53	0.0781	3.900
54	0.515	1.016	54	0.267	1.992	54	0.0790	3.882
55	0.506	1.042	55	0.259	2.038	55	0.0812	3.839
56	0.5004	1.059	56	0.272	1.961	56		
57		1.010	57	0.278	1.927	57		
58	0.519	1.004	58		2.096	58		
59	0.513	1.021	59	0.267	1.992	59		
60	0.519	0.989	60	0.280	1.944	60		
61	0.523	0.977	61	0.279	1.952			
62		1.000	62	0.274	1.979			
63	0.520	0.985	63	0.321	1.736, 2.080[n]			
64		1.018	64	0.275	1.974			
65	0.534	0.945	65	0.286	1.916			
66		1.004	66	0.266	2.022			
67		1.004	67	0.269	2.010			
68		0.981	68	0.279	1.951			
69		1.028	69	0.276	1.971			
70		0.976	70	0.270	2.004			
71		0.972	71	0.278	1.955			
72	0.533	0.963	72	0.282	1.933			
73	0.521	0.997	73	0.263	2.041			
74	0.512	1.024	74	0.275	1.973			
75	0.510	1.031	75	0.278	1.956			
76		0.988	76	0.270	2.002			
77	0.511	1.012	77	0.284	1.927			
78	0.494	1.062	78	0.285	1.922			
79	0.508	1.037	79	0.267	2.021			
80	0.516	1.013	80	0.270	2.003			

81		1.032	81	0.267	2.017			
82	0.517	1.009	82	0.278	1.957			
83	0.553	0.905	83	0.274	1.980, 2.091[n]			
84	0.522	0.995	84	0.258	2.041			
85	0.525	0.987	85	0.262	2.047, 2.094[n]			
86		1.044	86	0.271	1.999			
87	0.538	0.949	87	0.270	2.004			
88	0.501	1.057	88	0.271	1.999			
89	0.535	0.957	89	0.279	1.950			
90	0.514	1.019	90	0.268	1.982			
91	0.526	0.981	91	0.263	2.012			
92	0.508	1.037	92	0.270	1.973			
93	0.538	0.947	93	0.269	1.980			
94	0.526	0.982	94	0.271	1.969			
95			95	0.273	1.955			
96	0.526	0.984	96					
97	0.532	0.952	97	0.285	1.893			
98	0.507	1.023	98	0.271	1.969			
99	0.516	1.012	99	0.268	1.986			
100		1.014	100		2.097			
101	0.508	1.019, 1.015[n]	101		2.092			
102	0.517	0.994, 1.022[n]	102		2.071			
103		1.001	103		2.048			
104		1.014	104		2.069			
105		1.003	105		2.103			
106		0.995	106		2.046			
107		0.960	107		2.060			
108		1.003	108		2.077			

109		0.989	109		2.080			
110	0.505	1.046	110		2.080			
111	0.514	1.019	111		2.051			
112	0.506	1.025	112		2.061			
113	0.507	1.023	113		2.064			
114	0.513	1.005	114		2.071			
115	0.508	1.021, 1.008[n]	115		2.044			
116	0.508	1.020, 0.983[n]	116		2.053			
117			117		2.075			
118	0.509	1.018	118		2.084			
119			119		2.088			
120	0.510	1.029, 0.992[n]	120		2.080			
121	0.516	1.012	121		2.045			
122	0.538	0.933, 0.998[n]	122		2.034			
123	0.546	0.912, 1.004[n]	123		2.047			
124		1.037	124		2.052			
125	0.534	0.945	125		2.050			
126	0.533	0.963	126		2.063			
127	0.539	0.946	127		2.099			
128	0.552	0.895	128		2.052			
129	0.550	0.900	129		2.089			
130	0.549	0.904	130		2.061			
131	0.546	0.913	131		2.060			
132	0.544	0.917	132					
133	0.552	0.908, 0.912	133		2.072			
134	0.539	0.944	134		2.044			
135	0.536	0.953, 0.954	135		2.065			

136	0.00	0.880, 0.888	136		2.054			
137	0.560	0.887, 0.893	137		2.059			
138	0.564	0.877, 0.883	138		2.062			
139	0.563	0.879, 0.872	139		2.053			
140			140		2.081			
141	0.554	0.902, 0.923						
142	0.553	0.907						
143	0.547	0.923						
144	0.537	0.952						
145	0.556	0.897						
146	0.542	0.936						
146	0.536	0.941						
147	0.548	0.919						
147	0.544	0.917						
148	0.550	0.914						
149	0.551	0.911						
149	0.545	0.916						
150	0.544	0.931						
151	0.541	0.926						
152	0.532	0.951						
153	0.526	0.968						
154	0.514	1.002						
155	0.520	0.985						
156	0.544	0.918						
157								
158	0.519	0.988						
159	0.529	0.960						

160	0.516	1.011						
161								
162	0.533	0.961						
163	0.534	0.959						
164	0.526	0.984						
165	0.537	0.950						
166	0.537	0.950						
167	0.525	0.985						
168	0.534	0.958						
169	0.550	0.914						
170	0.516	1.010						
171	0.534	0.958						
172	0.540	0.943						
173	0.533	0.963						
174	0.551	0.912						
175	0.534	0.961						
176	0.544	0.932						
177	0.543	0.934						
178	0.530	0.972						
179	0.528	0.977						
180	0.534	0.961						
181	0.533	0.963						
182	0.543	0.934, 1.017[n]						
183	0.522	0.994						
184	0.521	0.996						
185	0.529	0.974						
186	0.525	0.987						
187	0.533	0.963						
188	0.535	0.956						

189	0.532	0.967						
190	0.529	0.973, 1.019[n]						
191	0.530	0.972, 1.022[n]						
192	0.519	1.002						
193	0.530	0.972, 0.989[n]						
194	0.521	0.997						
195	0.521	0.998, 1.015[n]						
196	0.518	1.006, 1.035[n]						
197	0.532	0.966						
198	0.531	0.967						
199	0.532	0.964						
200	0.524	0.988						
201	0.529	0.973						
202	0.523	0.991						
203	0.523	0.992						
204	0.536	0.953						
205	0.541	0.940						
206	0.537	0.950						
207	0.517	1.009						
208	0.523	0.990						
209	0.524	0.987						
210	0.528	0.976						
211	0.519	1.002						
212	0.529	0.973						
213	0.520	1.000						
214	0.529	0.973						
215	0.540	0.943						
216	0.527	0.979						
217	0.527	0.980						

218	0.524	0.989						
219	0.528	0.975						
220	0.531	0.967, 0.983[n]						
221	0.532	0.967						
222	0.530	0.972						
223	0.514	1.018, 1.015[n]						
224	0.539	0.946						
225	0.529	0.973						
226	0.532	0.965						
227	0.530	0.970						
228	0.529	0.974						
229	0.540	0.943						
230	0.537	0.950						
231	0.524	0.988						
232	0.532	0.966						
233	0.523	0.990						
234	0.537	0.951						
235	0.532	0.965						
236	0.521	0.997						
237	0.527	0.980						
238	0.531	0.969						
239	0.535	0.955						
240	0.529	0.973						
241	0.531	0.968						
242	0.532	0.966						
243	0.525	0.985						
244	0.532	0.964						
245	0.531	0.967						
246	0.537	0.951						

247	0.520	0.999						
248	0.529	0.974						
249	0.535	0.957						
250	0.531	0.969						
251	0.523	0.993						
252	0.514	1.018						
253	0.534	0.961						
254	0.537	0.952						
255	0.543	0.935						
256	0.521	0.997						
257	0.527	0.980						
258	0.532	0.966						
259	0.517	1.009						
260	0.532	0.966						
261	0.523	0.990						
262		1.031						
263		1.017						
264		1.000						
265		1.000						
266		1.009						
267		1.020						
268		1.006						
269		1.010						
270		1.013						
271		1.009						
272		0.978						
273								
274		1.009						
275		1.002						

276		0.995						
277		0.992						
278		0.993						
279		1.020						
280		0.993						
281		0.998						
282		1.009						
283		1.024						
284		1.037						
285		1.006						
286		1.037						
287		1.012						
288		1.018						
289		0.995						
290		0.962						
291		1.010						
292								

Table 2. Measured transmission of water and calculated sample thickness for USANS cells.

	2 mm			**5 mm**	
I.D.#	T	d_s (mm)	I.D.#	T	d_s (mm)
1	0.2768	1.964	1	0.03937	4.947
2	0.2745	1.977	2	0.03940	4.946
3	0.2744	1.978	3	0.03896	4.963
4	0.2741	1.980	4	0.03930	4.950
5	0.2738	1.981	5	0.03940	4.946
6	0.2721	1.990	6	0.03920	4.954
7	0.2733	1.984	7	0.03985	4.928
8	0.2737	1.981	8	0.03926	4.951
9	0.2732	1.985	9	0.03979	4.931
10	0.2725	1.988	10	0.03950	4.942
11			11		
12			12		
13			13		
14			14		
15			15		
16			16		
17			17		
18			18		
19			19		
20			20		
21			21		
22			22		
23			23		
24			24		
25			25		

26			26		
27			27		
28			28		
29			29		
30			30		