

Supplementary Materials

Table S1. Values for the eight surface topography indicators listed in Table 3 and the ultimate tensile strengths for all 216 tensile specimens; the location of the individual slices a, b, c, and d taken from the weld is specified in Figure 1.

Exp.	Slice	v_s	n	f_m	S_f	u_m	S_u	S_w	r_{arc}	S_d	V_{mp}	R_m
no.	-	mm/min	min ⁻¹	mm	mm	mm	mm	mm	-	mm	ml/m ³	MPa
1	a	500	500	0.105	0.026	-0.019	0.002	0.826	2.4	0.004	0.287	121.3
1	b	500	500	0.093	0.031	-0.023	0.002	0.801	2.533	0.006	0.287	125.4
1	c	500	500	0.093	0.013	-0.021	0.001	0.824	2.4	0.007	0.269	128.5
1	d	500	500	0.318	0.405	-0.138	0.187	3.185	1.533	0.356	33.129	132.2
2	a	500	700	0.126	0.012	-0.033	0.002	0.559	1	0.002	0.132	159.8
2	b	500	700	0.141	0.017	-0.045	0.003	0.358	1	0.001	0.143	160.1
2	c	500	700	0.15	0.021	-0.048	0.004	0.466	1	0.001	0.135	173
2	d	500	700	0.174	0.022	-0.042	0.005	0.156	1	0.001	0.146	187.7
3	a	500	900	0.145	0.02	-0.049	0.004	0.431	1	0.001	0.156	232
3	b	500	900	0.255	0.158	-0.063	0.016	1.34	1	0.002	0.163	232.4
3	c	500	900	0.273	0.161	-0.079	0.018	1.973	1	0.002	0.166	233.2
3	d	500	900	0.172	0.015	-0.05	0.002	0.116	1	0.002	0.151	232.9
4	a	500	1100	0.198	0.039	-0.073	0.005	0.727	1	0.003	0.23	237.4
4	b	500	1100	0.297	0.149	-0.084	0.011	1.33	1	0.004	0.233	237.6
4	c	500	1100	0.258	0.094	-0.088	0.01	1.156	1	0.002	0.247	237.9
4	d	500	1100	0.247	0.04	-0.081	0.014	1.659	1	0.005	0.231	238.3
5	a	500	1300	0.668	0.303	-0.102	0.008	1.739	1	0.003	0.4	239.5
5	b	500	1300	0.849	0.325	-0.153	0.021	1.791	1	0.004	0.357	239.1
5	c	500	1300	0.759	0.601	-0.118	0.019	1.068	1	0.002	0.387	238.9
5	d	500	1300	1.373	0.466	-0.202	0.054	1.406	1	0.004	0.369	238.9
6	a	500	1500	0.294	0.065	-0.081	0.005	0.985	0.978	0.006	0.546	239.7
6	b	500	1500	0.369	0.13	-0.093	0.008	1.282	1	0.004	0.587	239.5
6	c	500	1500	0.405	0.117	-0.103	0.008	1.418	1	0.005	0.51	238.8
6	d	500	1500	0.426	0.102	-0.112	0.007	1.307	1.022	0.005	0.52	239
7	a	500	1700	0.323	0.111	-0.093	0.008	0.926	1	0.005	1.108	239
7	b	500	1700	0.285	0.026	-0.103	0.007	0.954	0.961	0.015	0.711	238.5
7	c	500	1700	0.337	0.078	-0.104	0.007	1.307	1	0.004	0.647	238.3
7	d	500	1700	0.732	0.415	-0.107	0.011	1.543	1	0.005	0.653	238.4
8	a	500	1900	0.277	0.013	-0.092	0.008	0.344	0.965	0.011	0.796	238.6
8	b	500	1900	0.293	0.05	-0.096	0.007	0.715	1	0.005	1.067	238.4
8	c	500	1900	0.281	0.014	-0.102	0.006	0.397	0.982	0.003	0.339	238.1
8	d	500	1900	0.349	0.053	-0.105	0.005	0.815	0.965	0.007	0.364	238.3
9	a	500	2100	0.318	0.016	-0.097	0.007	0.361	0.984	0.006	0.689	239.4
9	b	500	2100	0.403	0.046	-0.112	0.015	1.111	0.952	0.006	0.539	237.3
9	c	500	2100	0.384	0.056	-0.116	0.008	0.824	0.952	0.009	1.085	237.9
9	d	500	2100	0.661	0.33	-0.141	0.018	0.852	0.952	0.006	0.957	237.6

10	a	500	2300	0.436	0.018	-0.118	0.007	0.159	0.913	0.005	0.33	237.2
10	b	500	2300	0.555	0.129	-0.164	0.012	1.823	0.913	0.004	0.379	236.4
10	c	500	2300	0.564	0.16	-0.182	0.003	2.553	0.855	0.005	0.311	235.8
10	d	500	2300	0.692	0.217	-0.19	0.006	1.206	0.942	0.004	0.309	236.5
11	a	500	2500	0.434	0.085	-0.12	0.024	2.291	0.8	0.008	1.145	237.3
11	b	500	2500	0.561	0.11	-0.169	0.026	1.208	0.853	0.004	0.355	234.9
11	c	500	2500	0.533	0.177	-0.171	0.015	1.478	0.8	0.003	0.405	235.4
11	d	500	2500	0.701	0.152	-0.152	0.009	1.706	0.827	0.004	0.335	236.3
12	a	500	2700	0.42	0.023	-0.118	0.015	0.163	0.531	0.008	0.563	237.1
12	b	500	2700	0.771	0.338	-0.194	0.015	1.171	0.593	0.007	1.04	235.5
12	c	500	2700	0.684	0.339	-0.17	0.03	1.577	0.716	0.018	1.58	234.9
12	d	500	2700	0.683	0.314	-0.192	0.031	1.435	0.642	0.009	0.49	235.5
13	a	500	2900	0.571	0.215	-0.168	0.031	0.891	0.54	0.023	1.531	234.9
13	b	500	2900	0.649	0.319	-0.165	0.028	3.278	0.736	0.005	0.466	233.8
13	c	500	2900	0.835	0.329	-0.198	0.01	1.403	0.632	0.003	0.386	234.5
13	d	500	2900	1.184	0.521	-0.227	0.039	2.688	0.598	0.013	0.292	234.8
14	a	500	3100	0.599	0.336	-0.189	0.031	1.366	0.419	0.016	0.542	235.3
14	b	500	3100	0.869	0.516	-0.19	0.016	1.289	0.43	0.007	0.52	234.1
14	c	500	3100	1.034	0.646	-0.173	0.035	1.596	0.376	0.019	0.869	234.1
14	d	500	3100	0.904	0.58	-0.202	0.021	1.334	0.484	0.005	0.539	233.3
15	a	500	3300	0.847	0.297	-0.176	0.039	1.783	0.343	0.02	0.898	233.9
15	b	500	3300	0.849	0.44	-0.181	0.013	1.824	0.505	0.012	0.835	232.1
15	c	500	3300	1.26	0.348	-0.252	0.039	3.948	0.384	0.025	0.823	232.2
15	d	500	3300	0.884	0.457	-0.211	0.017	1.108	0.444	0.008	0.405	232.6
16	a	500	3500	0.872	0.442	-0.193	0.033	1.149	0.295	0.016	0.453	234.8
16	b	500	3500	0.932	0.478	-0.17	0.012	0.912	0.343	0.007	0.517	235.1
16	c	500	3500	0.957	0.673	-0.193	0.014	1.456	0.371	0.005	0.403	232.1
16	d	500	3500	0.755	0.466	-0.217	0.014	1.147	0.276	0.017	0.576	233.2
17	a	1000	1100	0.135	0.007	-0.031	0.002	0.222	1.03	0.001	0.157	244.2
17	b	1000	1100	0.127	0.039	-0.037	0.004	0.707	1.03	0.002	0.169	244.4
17	c	1000	1100	0.158	0.065	-0.046	0.006	1.197	1.03	0.008	0.623	244.7
17	d	1000	1100	1.173	0.656	-0.731	0.4	4.865	1.091	0.492	32.984	245.3
18	a	1000	1300	0.183	0.014	-0.043	0.003	0.244	0.974	0.002	0.205	247.1
18	b	1000	1300	0.168	0.016	-0.047	0.004	0.249	0.974	0.005	0.361	246.4
18	c	1000	1300	0.613	0.437	-0.128	0.097	2.767	0.974	0.002	0.274	246.5
18	d	1000	1300	0.187	0.055	-0.053	0.007	0.875	1.026	0.004	0.266	246.8
19	a	1000	1500	0.178	0.027	-0.063	0.004	0.803	1.022	0.002	0.281	248.6
19	b	1000	1500	0.196	0.085	-0.066	0.004	1.197	1.022	0.003	0.349	248.2
19	c	1000	1500	0.188	0.039	-0.073	0.005	1.068	0.978	0.002	0.267	248
19	d	1000	1500	0.179	0.058	-0.069	0.006	1.083	0.978	0.002	0.251	248.3
20	a	1000	1700	0.187	0.026	-0.056	0.006	0.62	1.02	0.003	0.378	249.4
20	b	1000	1700	0.176	0.029	-0.07	0.006	0.823	0.98	0.005	0.378	249.2
20	c	1000	1700	0.188	0.036	-0.076	0.005	0.98	1.02	0.002	0.328	248.7

20	d	1000	1700	0.206	0.078	-0.074	0.004	1.028	1.02	0.003	0.338	249
21	a	1000	1900	0.207	0.013	-0.069	0.005	0.401	0.982	0.003	0.458	249.7
21	b	1000	1900	0.227	0.064	-0.075	0.009	1.237	0.982	0.005	0.574	249.8
21	c	1000	1900	0.177	0.015	-0.077	0.004	0.548	0.982	0.005	0.543	249.5
21	d	1000	1900	0.193	0.026	-0.079	0.006	0.597	1.018	0.003	0.525	249.9
22	a	1000	2100	0.202	0.041	-0.062	0.004	1.327	1.016	0.004	0.462	250
22	b	1000	2100	0.191	0.024	-0.067	0.008	0.208	1.016	0.003	0.277	250
22	c	1000	2100	0.185	0.031	-0.069	0.004	0.882	1.016	0.003	0.306	250
22	d	1000	2100	0.189	0.012	-0.067	0.003	0.094	1.016	0.003	0.263	249.9
23	a	1000	2300	0.279	0.262	-0.072	0.013	0.277	1.014	0.003	0.342	251.4
23	b	1000	2300	0.207	0.019	-0.068	0.004	0.285	0.986	0.002	0.221	251.3
23	c	1000	2300	0.214	0.011	-0.073	0.004	0.172	0.986	0.002	0.212	251.1
23	d	1000	2300	0.23	0.039	-0.076	0.004	0.651	0.986	0.003	0.169	250.5
24	a	1000	2500	0.216	0.065	-0.066	0.006	0.525	0.987	0.003	0.297	249.6
24	b	1000	2500	0.213	0.01	-0.066	0.003	0.235	0.987	0.002	0.267	250.1
24	c	1000	2500	0.22	0.015	-0.072	0.003	0.44	0.987	0.003	0.293	250.4
24	d	1000	2500	0.222	0.009	-0.076	0.003	0.055	1.013	0.003	0.334	250.4
25	a	1000	2700	0.212	0.013	-0.063	0.005	0.109	0.988	0.002	0.387	250
25	b	1000	2700	0.218	0.019	-0.068	0.007	0.785	0.988	0.002	0.305	249.2
25	c	1000	2700	0.223	0.012	-0.07	0.005	0.161	1.012	0.003	0.381	249
25	d	1000	2700	0.241	0.013	-0.073	0.005	0.059	0.988	0.002	0.324	248.7
26	a	1000	2900	0.211	0.02	-0.063	0.004	0.107	0.989	0.003	0.321	250.7
26	b	1000	2900	0.22	0.026	-0.065	0.004	0.336	1.011	0.003	0.373	251
26	c	1000	2900	0.236	0.034	-0.068	0.007	0.6	1.011	0.003	0.378	250.7
26	d	1000	2900	0.248	0.047	-0.069	0.008	0.436	1.011	0.004	0.549	250.8
27	a	1000	3100	0.238	0.012	-0.059	0.004	0.101	1.011	0.004	0.425	249.1
27	b	1000	3100	0.239	0.021	-0.069	0.004	0.146	0.989	0.003	0.475	248.7
27	c	1000	3100	0.266	0.028	-0.074	0.005	0.156	1.011	0.01	0.916	248.4
27	d	1000	3100	0.473	0.154	-0.083	0.012	2.443	0.989	0.004	0.484	248.7
28	a	1000	3300	0.91	0.214	-0.167	0.013	1.387	1.01	0.008	1.632	246.2
28	b	1000	3300	0.339	0.018	-0.087	0.004	0.34	0.97	0.012	0.545	245.1
28	c	1000	3300	0.945	0.362	-0.153	0.023	1.675	1.01	0.009	0.416	244.8
28	d	1000	3300	0.842	0.391	-0.155	0.013	2.057	0.99	0.005	0.827	246.3
29	a	1000	3500	0.302	0.025	-0.073	0.014	1.496	0.838	0.048	5.832	248.1
29	b	1000	3500	1.032	0.594	-0.113	0.008	1.418	0.952	0.011	2.17	246.6
29	c	1000	3500	1.101	0.425	-0.254	0.1	1.871	0.857	0.031	4.117	245.7
29	d	1000	3500	0.8	0.373	-0.142	0.006	1.738	0.971	0.018	1.096	245.2
30	a	1000	3700	1.003	0.472	-0.241	0.207	2.143	0.793	0.055	5.398	245.8
30	b	1000	3700	0.8	0.341	-0.175	0.031	1.47	0.829	0.026	1.907	244.7
30	c	1000	3700	0.846	0.412	-0.13	0.011	2.431	0.991	0.004	1.485	244.2
30	d	1000	3700	0.945	0.278	-0.288	0.11	2.213	0.973	0.009	1.001	244.7
31	a	1000	3900	0.677	0.417	-0.136	0.007	1.186	0.872	0.018	2.139	244.9
31	b	1000	3900	0.715	0.316	-0.141	0.006	0.98	0.974	0.008	1.055	244.3

31	c	1000	3900	0.691	0.493	-0.147	0.011	1.194	0.957	0.01	0.612	244.1
31	d	1000	3900	0.88	0.669	-0.151	0.005	1.383	0.957	0.005	1.083	244.4
32	a	1000	4100	0.733	0.424	-0.142	0.011	1.258	0.764	0.029	2.42	244.3
32	b	1000	4100	0.816	0.496	-0.154	0.009	1.087	0.959	0.011	1.612	244.2
32	c	1000	4100	0.909	0.509	-0.155	0.009	1.005	0.602	0.03	2.832	243.6
32	d	1000	4100	1.271	0.394	-0.524	0.308	1.603	0.927	0.012	1.984	243.9
33	a	1000	4300	1.062	0.617	-0.092	0.02	2.203	0.822	0.028	3.449	246.5
33	b	1000	4300	1.179	0.665	-0.138	0.009	1.46	0.822	0.029	3.31	246.1
33	c	1000	4300	0.93	0.493	-0.153	0.032	2.205	0.791	0.022	3.421	246.6
33	d	1000	4300	1.44	0.54	-0.434	0.4	2.522	0.729	0.02	2.026	247.2
34	a	1000	4500	0.708	0.243	-0.15	0.024	2.735	0.919	0.007	3.159	243.7
34	b	1000	4500	1.054	0.552	-0.14	0.012	1.971	0.948	0.005	3.26	245.6
34	c	1000	4500	1.173	1.012	-0.157	0.017	1.917	0.859	0.013	10.894	244.9
34	d	1000	4500	1.069	0.763	-0.146	0.013	1.634	0.919	0.008	6.302	245.7
35	a	1000	4700	1.07	0.362	-0.176	0.036	2.492	0.894	0.003	0.895	216.6
35	b	1000	4700	1.037	0.506	-0.165	0.015	2.334	0.879	0.005	3.059	240.6
35	c	1000	4700	1.162	0.452	-0.179	0.02	1.69	0.851	0.004	1.722	243.8
35	d	1000	4700	1.122	0.488	-0.235	0.046	1.87	0.823	0.006	5.708	244.3
36	a	1000	4900	0.728	0.438	-0.147	0.015	1.483	0.844	0.003	1.595	212.7
36	b	1000	4900	1.458	0.607	-0.183	0.029	5.575	0.789	0.007	6.249	227.7
36	c	1000	4900	1.281	0.337	-0.218	0.033	1.897	0.68	0.005	2.591	216.5
36	d	1000	4900	1.089	0.604	-0.186	0.041	2.455	0.721	0.012	14.096	244.9
37	a	1500	1500	0.15	0.019	-0.033	0.002	0.446	1	0.001	0.221	251.9
37	b	1500	1500	0.142	0.015	-0.035	0.002	0.738	1	0.002	0.233	251.9
37	c	1500	1500	0.151	0.016	-0.037	0.002	0.323	1	0.001	0.231	252.2
37	d	1500	1500	0.154	0.024	-0.037	0.002	0.624	1	0.008	0.248	252.6
38	a	1500	1700	0.137	0.014	-0.04	0.001	1.367	1.059	0.011	0.369	254.4
38	b	1500	1700	0.133	0.034	-0.045	0.004	2.175	1.118	0.018	0.905	254.8
38	c	1500	1700	0.142	0.022	-0.044	0.001	1.194	1	0.002	0.298	254.6
38	d	1500	1700	0.133	0.021	-0.045	0.001	0.798	1	0.004	0.3	254.4
39	a	1500	1900	0.217	0.109	-0.05	0.003	2.86	1	0.006	0.486	255.3
39	b	1500	1900	0.15	0.033	-0.051	0.001	1.2	1	0.003	0.271	255.1
39	c	1500	1900	0.141	0.011	-0.052	0.001	0.323	1	0.002	0.238	255.2
39	d	1500	1900	0.151	0.039	-0.056	0.001	0.485	1	0.002	0.215	255.7
40	a	1500	2100	0.136	0.009	-0.053	0.001	0.603	1	0.003	0.266	254.4
40	b	1500	2100	0.143	0.019	-0.059	0.001	0.131	1	0.002	0.271	254.2
40	c	1500	2100	0.135	0.018	-0.065	0.002	0.16	1	0.005	0.242	254.5
40	d	1500	2100	0.133	0.013	-0.065	0.002	0.93	1	0.003	0.29	254.9
41	a	1500	2300	0.151	0.028	-0.07	0.008	0.348	1	0.004	0.313	254.6
41	b	1500	2300	0.134	0.017	-0.066	0.001	0.444	1	0.003	0.284	254.9
41	c	1500	2300	0.135	0.018	-0.075	0.003	0.253	1	0.004	0.301	255
41	d	1500	2300	0.149	0.024	-0.071	0.002	0.286	1	0.004	0.348	254.1
42	a	1500	2500	0.213	0.117	-0.068	0.004	1.424	1	0.008	0.444	255.2

42	b	1500	2500	0.143	0.019	-0.07	0.004	0.189	1	0.003	0.376	255.8
42	c	1500	2500	0.146	0.016	-0.072	0.003	0.154	1	0.005	0.46	255.9
42	d	1500	2500	0.138	0.015	-0.068	0.003	0.332	1	0.003	0.453	256.4
43	a	1500	2700	0.125	0.031	-0.059	0.005	0.143	1	0.004	0.423	256.9
43	b	1500	2700	0.127	0.013	-0.061	0.004	0.062	1	0.003	0.353	256.9
43	c	1500	2700	0.133	0.017	-0.065	0.004	0.275	1	0.003	0.416	256.8
43	d	1500	2700	0.139	0.012	-0.062	0.004	0.061	1	0.004	0.371	256.9
44	a	1500	2900	0.169	0.015	-0.06	0.004	0.746	0.966	0.011	1.172	256.8
44	b	1500	2900	0.152	0.02	-0.062	0.006	0.842	1.034	0.019	1.083	257
44	c	1500	2900	0.265	0.273	-0.066	0.006	1.153	1.034	0.01	0.978	256.7
44	d	1500	2900	0.156	0.018	-0.061	0.007	0.514	1	0.009	0.728	257.5
45	a	1500	3100	0.155	0.029	-0.052	0.003	0.681	1	0.009	0.617	256.5
45	b	1500	3100	0.154	0.021	-0.054	0.004	0.917	0.968	0.032	1.542	256.1
45	c	1500	3100	0.149	0.012	-0.055	0.004	0.554	0.968	0.017	1.876	256.5
45	d	1500	3100	0.159	0.015	-0.052	0.002	1.399	1	0.021	2.852	256.8
46	a	1500	3300	0.215	0.036	-0.054	0.004	2.303	1	0.046	5.047	254.7
46	b	1500	3300	0.911	0.656	-0.13	0.066	2.465	1.212	0.034	5.194	254.6
46	c	1500	3300	0.2	0.029	-0.06	0.005	2.642	0.939	0.036	5.524	254.9
46	d	1500	3300	0.233	0.016	-0.057	0.007	2.014	0.909	0.053	4.29	254.9
47	a	1500	3500	0.666	0.358	-0.065	0.015	2.347	0.971	0.056	5.498	253.8
47	b	1500	3500	0.239	0.008	-0.055	0.002	0.89	0.914	0.046	5.176	253.3
47	c	1500	3500	0.249	0.022	-0.059	0.014	2.103	0.8	0.058	6.249	252.9
47	d	1500	3500	0.515	0.271	-0.067	0.006	2.784	0.943	0.038	4.248	253.8
48	a	1500	3700	0.906	0.434	-0.166	0.098	2.386	0.946	0.022	4.829	253.8
48	b	1500	3700	0.296	0.071	-0.059	0.008	1.421	0.838	0.053	5.258	253.5
48	c	1500	3700	0.265	0.025	-0.064	0.005	2.251	0.811	0.063	6.685	253.1
48	d	1500	3700	0.271	0.018	-0.072	0.006	0.542	1.054	0.033	3.831	253.7
49	a	1500	3900	0.278	0.039	-0.06	0.004	1.601	0.949	0.048	5.899	253.3
49	b	1500	3900	0.243	0.012	-0.066	0.005	1.166	0.769	0.06	5.584	253.8
49	c	1500	3900	0.293	0.048	-0.075	0.008	1.746	0.949	0.04	6.221	253.2
49	d	1500	3900	0.293	0.011	-0.078	0.005	1.103	1	0.027	5.752	252.8
50	a	1500	4100	0.275	0.022	-0.063	0.01	1.286	0.927	0.03	5.068	250.2
50	b	1500	4100	0.707	0.351	-0.122	0.076	3.915	0.951	0.038	5.219	250.2
50	c	1500	4100	1.327	0.434	-0.272	0.3	2.365	0.854	0.032	5.873	250.6
50	d	1500	4100	0.292	0.035	-0.067	0.005	1.119	0.878	0.043	4.978	250.4
51	a	1500	4300	0.209	0.033	-0.057	0.008	3.272	0.698	0.057	5.516	250.8
51	b	1500	4300	1.108	0.425	-0.155	0.073	2.782	0.93	0.079	9.811	251.3
51	c	1500	4300	1.031	0.342	-0.11	0.021	2.312	0.977	0.03	7.776	251.5
51	d	1500	4300	0.311	0.046	-0.069	0.014	2.4	0.884	0.058	7.854	251.8
52	a	1500	4500	1.606	0.951	-0.09	0.034	2.216	0.911	0.018	2.451	252.6
52	b	1500	4500	0.258	0.017	-0.052	0.006	0.602	1	0.006	3.578	252.6
52	c	1500	4500	0.275	0.065	-0.048	0.003	1.602	0.956	0.01	2.653	252.4
52	d	1500	4500	0.246	0.012	-0.06	0.006	0.07	0.978	0.007	2.343	252.6

53	a	1500	4700	0.259	0.019	-0.051	0.003	0.783	0.894	0.012	3.157	252.7
53	b	1500	4700	0.277	0.016	-0.056	0.003	0.164	0.936	0.016	2.938	253.7
53	c	1500	4700	0.266	0.016	-0.055	0.005	0.651	0.894	0.017	2.703	252.6
53	d	1500	4700	0.266	0.014	-0.054	0.004	0.585	0.915	0.024	3.394	252.6
54	a	1500	4900	0.654	0.4	-0.123	0.031	3.666	0.898	0.018	3.718	251.2
54	b	1500	4900	0.751	0.482	-0.104	0.049	3.014	0.898	0.015	1.581	251.6
54	c	1500	4900	0.972	0.382	-0.116	0.043	2.663	0.816	0.048	7.114	251.8
54	d	1500	4900	0.299	0.033	-0.057	0.005	1.285	0.878	0.026	4.183	238