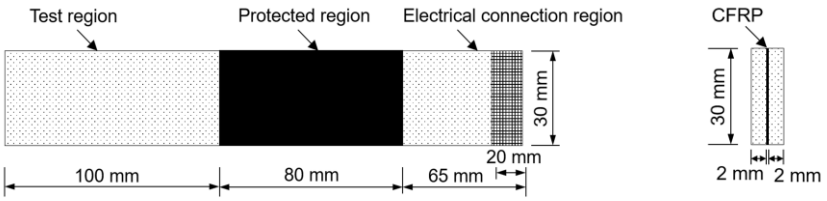
Supporting Information

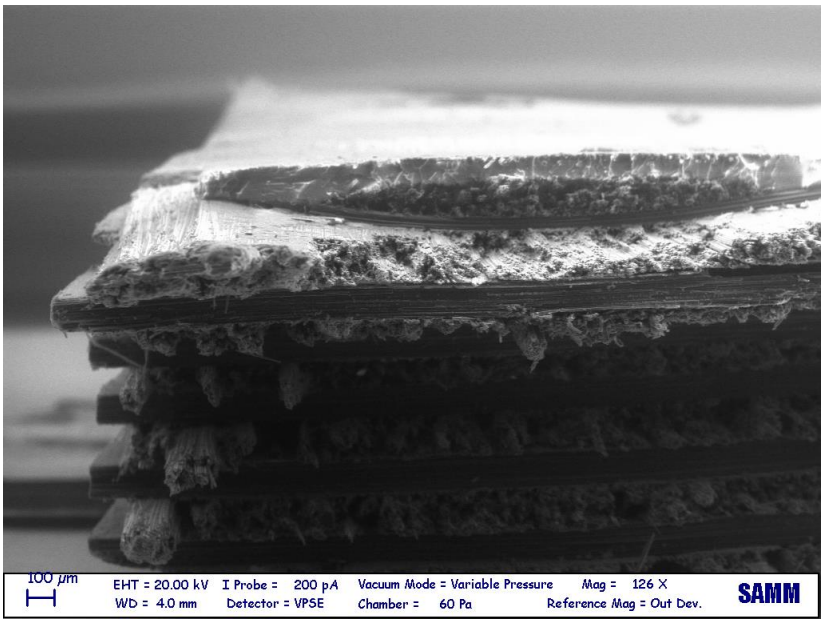
Green and No-Size-Limit Recycling of CFRP by Electrically Driven Heterogeneous Catalysis

Table SI 1 Experimental data of epoxy resin removal

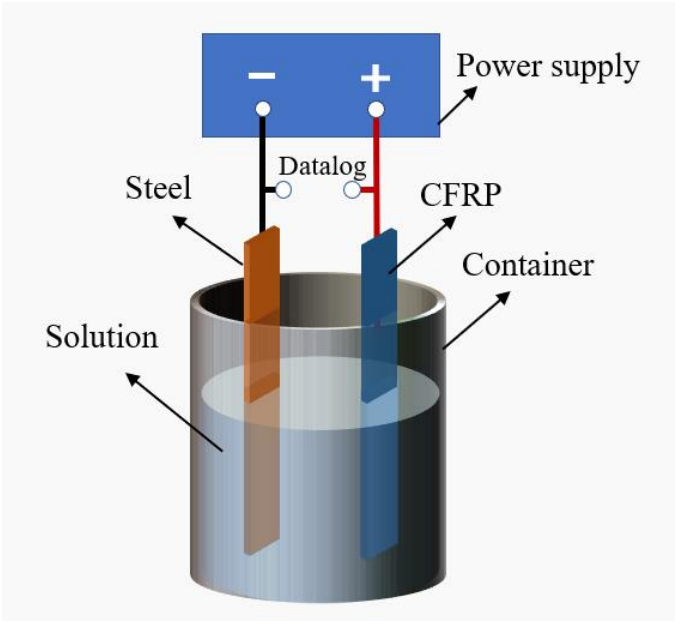
Specimens	I20S0.5	I20S1	I20S2	I20S3	I40S0.5	I40S1
Parallel test results	67.9	89.3	95.1	89.6	66.3	89.0
	67.7	89.4	95.9	91.2	67.0	88.9
	69.4	90.1	96.3	90.5	67.9	90.1
Mean	68.3	89.6	95.8	90.4	67.1	89.3
CoV	0.014	0.005	0.006	0.009	0.012	0.007
Specimens	I40S2	I40S3	I62.5S0.5	I62.5S1	I62.5S2	I62.5S3
Parallel test results	93.0	90.7	64.2	66.6	68.3	68.8
	93.4	89.5	64.1	65.9	68.4	64.5
	94.7	89.1	61.6	64.0	68.8	65.1
Mean	93.7	89.8	63.3	65.5	68.5	66.1
CoV	0.009	0.009	0.023	0.021	0.004	0.035
Specimens	I20S1K0.5	I20S1K1	I20S1K1.5	I20S2K0.5	I20S2K1	I20S2K1.5
Parallel test results	100.0	99.4	100.0	100.0	99.6	99.9
	99.9	98.7	100.0	99.9	99.7	98.8
	99.2	100.6	100.0	99.6	99.7	99.9
Mean	99.7	99.6	100.0	99.8	99.7	99.5
CoV	0.004	0.010	0.000	0.002	0.001	0.006
Specimens	I20S3K0.5	I20S3K1	I20S3K1.5	I40S1K0.5	I40S1K1	I40S1K1.5
Parallel test results	100.0	99.5	99.8	99.9	100.0	99.9
	99.9	99.8	99.4	99.9	99.4	99.5
	99.9	99.9	99.6	99.2	99.8	99.5
Mean	99.9	99.7	99.6	99.7	99.6	99.6
CoV	0.001	0.002	0.002	0.004	0.003	0.002
Specimens	I40S2K0.5	I40S2K1	I40S2K1.5	I40S3K0.5	I40S3K1	I40S3K1.5
Parallel test results	99.3	99.6	99.7	99.7	99.9	99.1
	98.9	99.9	99.8	99.2	99.9	99.8
	99.9	100.0	99.2	99.5	99.6	99.1
Mean	99.4	99.8	99.6	99.5	99.8	99.3
CoV	0.005	0.002	0.003	0.003	0.002	0.004
Specimens	I20S2K1T40	I20S2K1T60	I20S2K1T75	I40S2K1T40	I40S2K1T60	I40S2K1T75
Parallel test results	99.4	100.0	99.7	99.2	99.5	99.8
	99.2	99.9	99.9	99.5	99.6	99.8
	99.9	99.9	99.9	99.1	99.2	99.5
Mean	99.5	99.9	99.8	99.3	99.4	99.7
CoV	0.004	0.001	0.001	0.002	0.002	0.002



（a）Front view （b）Cross-section



(c) SEM image of a typical CFRP sample



(d) Recycling system

Figure SI 1. Composition, structure and testing of CFRPs. a) Front and b) cross-sectional views. c) Representative SEM image. d) Schematic of the recycling system.

Table SI 2. Components of the epoxy resin

Components	Mass fraction (%)
Bisphenol-A-type epoxy resin	37～38
Novolac epoxy resin	19～20
Dicyandiamide	5～6
Methyl ethyl ketone	36～37

Table SI 3. Labelling system of the test specimens

Test unit	Specimens	Current I (mA)	Current density J (A/m2)	NaCl concentration S (%)	KOH concentration K (g/L)	Temperature (℃)
1	I20S0.5	20	3.33	0.5	0	25
	I20S1	20	3.33	1.0	0	25
	I20S2	20	3.33	2.0	0	25
	I20S3	20	3.33	3.0	0	25
	I40S0.5	40	6.67	0.5	0	25
	I40S1	40	6.67	1.0	0	25
	I40S2	40	6.67	2.0	0	25
	I40S3	40	6.67	3.0	0	25
	I62.5S0.5	62.5	10.42	0.5	0	25
	I62.5S1	62.5	10.42	1.0	0	25
	I62.5S2	62.5	10.42	2.0	0	25
	I62.5S3	62.5	10.42	3.0	0	25
	I78.1S0.5	78.1	13.20	0.5	0	25
	I78.1S1	78.1	13.20	1.0	0	25
	I78.1S2	78.1	13.20	2.0	0	25
	I78.1S3	78.1	13.20	3.0	0	25
	I104.2S0.5	104.2	17.36	0.5	0	25
	I104.2S1	104.2	17.36	1.0	0	25
	I104.2S2	104.2	17.36	2.0	0	25
	I104.2S3	104.2	17.36	3.0	0	25
	I156.3S0.5	156.3	26.04	0.5	0	25
	I156.3S1	156.3	26.04	1.0	0	25
	I156.3S2	156.3	26.04	2.0	0	25
	I156.3S3	156.3	26.04	3.0	0	25
2	I20S1K0.5	20	3.33	1.0	0.5	25
	I20S1K1	20	3.33	1.0	1.0	25
	I20S1K1.5	20	3.33	1.0	1.5	25
	I20S2K0.5	20	3.33	2.0	0.5	25
	I20S2K1	20	3.33	2.0	1.0	25
	I20S2K1.5	20	3.33	2.0	1.5	25
	I20S3K0.5	20	3.33	3.0	0.5	25
	I20S3K1	20	3.33	3.0	1.0	25
	I20S3K1.5	20	3.33	3.0	1.5	25
	I40S1K0.5	40	6.67	1.0	0.5	25
	I40S1K1	40	6.67	1.0	1.0	25
	I40S1K1.5	40	6.67	1.0	1.5	25
	I40S2K0.5	40	6.67	2.0	0.5	25
	I40S2K1	40	6.67	2.0	1.0	25
	I40S2K1.5	40	6.67	2.0	1.5	25
	I40S3K0.5	40	6.67	3.0	0.5	25
	I40S3K1	40	6.67	3.0	1.0	25
	I40S3K1.5	40	6.67	3.0	1.5	25
3	I20S2K1T40	20	3.33	2.0	1.0	40
	I20S2K1T60	20	3.33	2.0	1.0	60
	I20S2K1T75	20	3.33	2.0	1.0	75
	I40S2K1T40	40	6.67	2.0	1.0	40
	I40S2K1T60	40	6.67	2.0	1.0	60
	I40S2K1T75	40	6.67	2.0	1.0	75

Recycled Carbon Fibers

System voltage

During an electrochemical recovery process, carbon fibers can degrade and increase the resistivity of the sample, causing changes in the system voltage. The trial test of sample voltage monitoring shows that the smaller the current density is, the smaller and more stable the voltage is during electrochemical recovery. In the recovery cycle, the NaCl concentration has little effect on the voltage. When the NaCl concentration is 2%, the sample voltage is the lowest of the examined samples, and thus, the energy consumed during the recovery process is the lowest. Therefore, a concentration of 2% was selected as the optimal NaCl concentration. The concentration of the catalyst, KOH, has a negligible effect on the sample voltage, especially under low current conditions. Figure SI 2(c) shows that the voltage for all samples ranges from 2.5 to 3.1 V, and the sample voltage is essentially stable during the entire recovery period, indicating that the sample does not experience significant deterioration. The energy consumption of the test sample is the product of the voltage, the current and the elapsed time. Therefore, the recovery system voltage can be used to assess carbon fiber degradation and energy consumption in different recovery processes. In summary, if the NaCl concentration is 2% and the current density is 3.33 or 6.67 A/m^2, the system voltage is stable, and the sample does not significantly degrade and the energy consumption is minimal.

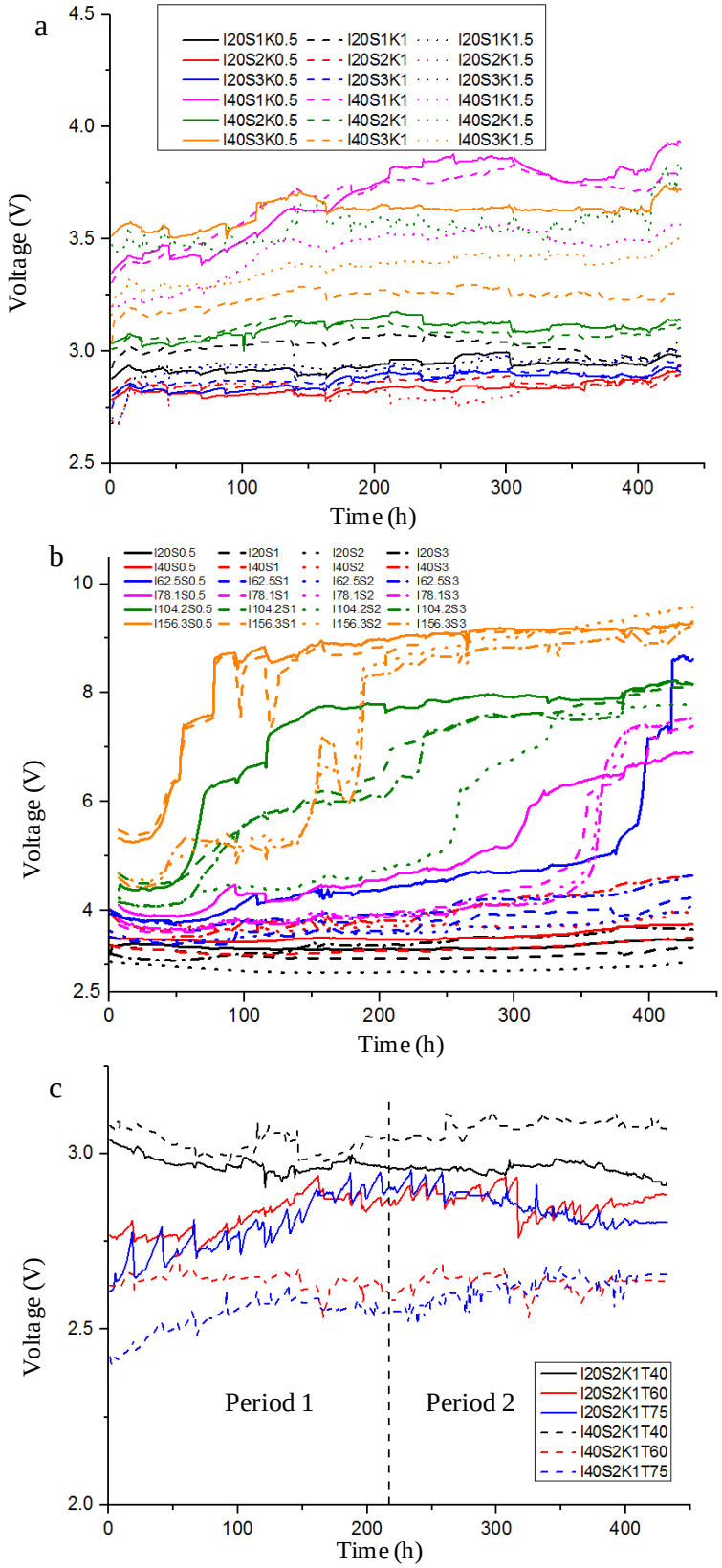


Figure SI 2 Plot of system voltage a. Effect of NaCl concentration; b. Effect of KOH concentration; c. Effect of temperature.

Table SI 4 Experimental results of tensile tests

Specimens	VCF	I20S0.5	I20S1	I20S2	I20S3	I40S0.5	I40S1	I40S2	I40S3	I62.5S0.5	I62.5S1	I62.5S2	I62.5S3
Parallel test results	4.592	2.578	3.482	3.658	3.442	2.672	3.368	3.595	3.558	2.345	2.451	2.489	2.485
	4.331	2.454	3.607	3.465	3.546	2.475	3.486	3.574	3.408	2.311	2.591	2.460	2.466
	4.719	2.654	3.675	3.856	3.575	2.657	3.337	3.589	3.382	2.475	2.576	2.779	2.657
	4.361	2.753	3.427	3.746	3.389	2.561	3.478	3.720	3.363	2.456	2.310	2.443	2.389
	4.890	2.692	3.234	3.862	3.462	2.564	3.556	3.571	3.514	2.228	2.410	2.752	2.387
	4.649	2.641	3.561	3.845	3.561	2.471	3.409	3.540	3.465	2.475	2.618	2.566	2.565
	4.672	2.696	3.543	3.991	3.398	2.444	3.451	3.572	3.557	2.477	2.589	2.354	2.490
	4.785	2.513	3.669	3.851	3.456	2.659	3.399	3.537	3.300	2.441	2.352	2.622	2.565
	4.879	2.493	3.231	3.946	3.438	2.671	3.319	3.901	3.462	2.292	2.584	2.463	2.509
	4.501	2.617	3.279	3.915	3.409	2.475	3.366	3.800	3.471	2.461	2.434	2.442	2.567
	4.635	2.628	3.375	3.887	3.456	2.659	3.417	3.772	3.578	2.375	2.341	2.787	2.677
	4.481	2.619	3.597	3.804	3.616	2.541	3.577	3.620	3.298	2.556	2.441	2.361	2.329
	4.434	2.497	3.354	3.615	3.547	2.577	3.222	3.737	3.590	2.203	2.563	2.509	2.389
	4.674	2.785	3.563	3.648	3.481	2.554	3.396	3.802	3.565	2.430	2.510	2.689	2.343
	4.590	2.760	3.635	3.542	3.567	2.686	3.398	3.892	3.567	2.530	2.489	2.501	2.507
	4.422	2.754	3.384	3.834	3.501	2.476	3.268	3.789	3.456	2.345	2.551	2.672	2.666
	4.726	2.456	3.667	3.588	3.586	2.549	3.563	3.780	3.454	2.546	2.444	2.459	2.501
	4.709	2.753	3.498	3.921	3.364	2.751	3.448	3.610	3.376	2.301	2.353	2.522	2.534
	4.898	2.732	3.412	3.479	3.513	2.704	3.422	3.547	3.410	2.266	2.401	2.677	2.529
	4.875	2.607	3.241	3.902	3.451	2.512	3.450	3.907	3.378	2.207	2.416	2.690	2.620
Mean	4.641	2.634	3.472	3.768	3.488	2.583	3.417	3.693	3.458	2.386	2.471	2.562	2.509
CoV	0.038	0.041	0.044	0.043	0.021	0.036	0.027	0.035	0.027	0.048	0.039	0.053	0.041

Table SI 4 Cont.

Specimens	I20S1K0.5	I20S1K1	I20S1K1.5	I20S2K0.5	I20S2K1	I20S2K1.5	I20S3K0.5	I20S3K1	I20S3K1.5
Parallel test results	3.566	3.384	3.101	3.357	3.298	3.211	3.590	3.484	2.781
	3.290	3.369	3.109	3.256	3.212	3.090	3.212	3.059	2.798
	3.478	3.338	3.087	3.467	3.209	3.085	3.390	3.487	3.098
	3.298	3.283	2.676	3.679	3.487	2.908	3.297	3.478	2.915
	3.383	3.291	2.666	3.557	3.658	2.979	3.201	3.477	3.054
	3.275	3.107	2.657	3.653	3.109	3.172	3.672	3.481	2.776
	3.367	3.108	3.085	3.331	3.197	3.001	3.567	3.013	2.806
	3.518	2.978	2.622	3.678	3.110	2.889	3.278	3.567	2.872
	3.303	3.324	3.098	3.333	3.612	2.980	3.284	3.200	3.098
	3.311	3.261	2.708	3.365	3.411	3.109	3.578	3.156	3.095
	3.466	3.110	2.890	3.588	3.131	3.103	3.256	3.051	2.915
	3.254	3.246	2.955	3.265	3.617	2.994	3.589	3.082	3.108
	3.477	3.101	3.009	3.390	3.356	2.988	3.261	3.001	3.067
	3.354	3.006	3.004	3.467	3.399	2.994	3.334	3.101	3.088
	3.490	3.018	3.065	3.415	3.587	3.039	3.290	2.993	3.104
	3.319	3.090	3.050	3.586	3.100	2.906	3.458	2.981	3.061
	3.474	3.003	3.043	3.267	3.121	2.988	3.592	3.053	2.895
	3.344	3.062	3.098	3.272	3.188	3.056	3.635	3.095	2.798
	3.487	3.093	3.078	3.270	3.293	3.034	3.202	2.997	3.004
	3.520	3.122	3.041	3.320	3.105	2.903	3.577	3.199	2.994
Mean	3.399	3.165	2.952	3.426	3.310	3.021	3.413	3.198	2.966
CoV	0.029	0.042	0.060	0.043	0.059	0.029	0.049	0.066	0.043

Table SI 4 Cont.

Specimens	I40S1K0.5	I40S1K1	I40S1K1.5	I40S2K0.5	I40S2K1	I40S2K1.5	I40S3K0.5	I40S3K1	I40S3K1.5
Parallel test results	3.398	3.076	2.590	3.410	2.929	3.057	3.467	3.029	2.647
	3.587	3.098	2.487	3.095	2.887	2.489	3.498	3.073	2.447
	3.346	3.109	2.876	3.198	2.567	2.987	3.309	2.980	2.594
	3.285	2.870	2.776	3.196	2.768	2.609	3.161	2.812	2.569
	3.577	2.975	2.640	3.109	2.898	2.897	3.267	2.820	2.456
	3.409	3.087	2.561	3.322	2.785	2.563	3.180	2.986	2.768
	3.480	3.109	2.567	3.310	2.900	2.590	3.134	3.076	2.901
	3.201	3.008	2.567	3.561	2.765	2.556	3.295	2.860	2.903
	3.242	3.110	2.721	3.170	2.890	2.546	3.476	3.048	2.789
	3.498	2.809	2.652	3.592	2.710	2.698	3.550	2.971	2.550
	3.108	2.891	2.803	3.562	2.667	3.056	3.534	2.790	2.458
	3.103	2.787	2.709	3.545	2.583	3.090	3.481	2.947	2.487
	3.582	3.046	2.498	3.573	2.979	2.769	3.209	3.050	2.649
	3.220	3.167	2.820	3.365	3.004	2.890	3.356	3.011	2.469
	3.341	2.868	2.750	3.555	2.921	2.612	3.487	2.809	2.576
	3.361	2.901	2.816	3.274	2.735	2.680	3.301	2.783	2.878
	3.309	2.897	2.683	3.290	2.620	2.457	3.221	2.799	2.633
	3.202	2.998	2.661	3.180	2.541	2.780	3.370	2.789	2.877
	3.544	3.005	2.540	3.453	2.590	2.466	3.345	2.762	2.765
	3.343	2.785	2.610	3.546	2.776	2.899	3.320	2.803	2.793
Mean	3.357	2.980	2.666	3.365	2.776	2.735	3.348	2.910	2.660
CoV	0.045	0.040	0.043	0.051	0.053	0.077	0.039	0.040	0.061

Table SI 4 Cont.

Specimens	I20S2K1T40	I20S2K1T60	I20S2K1T75	I40S2K1T40	I40S2K1T60	I40S2K1T75
Parallel test results	3.661	4.098	4.311	3.768	4.008	4.243
	3.587	4.167	3.999	3.625	4.123	4.253
	3.663	3.948	4.203	3.611	4.127	4.187
	3.656	4.047	4.020	3.899	4.098	4.087
	3.902	4.146	3.990	3.567	4.245	3.989
	3.658	4.100	4.123	3.895	4.089	3.981
	3.787	4.109	4.010	3.817	4.243	4.104
	3.655	4.255	4.006	3.895	4.096	4.007
	3.761	4.178	3.995	3.802	4.071	4.082
	3.789	3.993	3.939	3.566	4.014	4.276
	3.754	3.982	4.277	3.689	4.099	4.280
	3.653	4.017	4.090	3.698	4.247	4.341
	3.879	3.999	3.989	3.787	4.202	4.399
	3.889	3.921	3.998	3.677	4.109	3.998
	3.909	4.018	4.003	3.812	4.088	4.087
	3.804	3.945	3.909	3.903	3.999	4.245
	3.820	3.991	4.321	3.890	4.024	4.175
	3.729	3.998	4.126	3.728	4.266	4.151
	3.810	3.991	4.089	3.710	4.156	4.085
	3.812	3.990	4.265	3.829	4.209	4.063
Mean	3.759	4.045	4.083	3.758	4.126	4.152
CoV	0.026	0.022	0.031	0.030	0.021	0.030

Table SI 5 Measured diameters of carbon fiber

Specimens	VCF	I20S0.5	I20S1	I20S2	I20S3	I40S0.5	I40S1	I40S2	I40S3	I62.5S0.5	I62.5S1	I62.5S2	I62.5S3
Parallel test results	7.01	6.93	6.97	6.95	6.96	6.94	6.94	6.90	6.94	6.99	6.91	6.90	6.98
	6.97	6.95	6.93	6.92	6.97	6.98	6.99	6.92	6.90	7.22	6.99	6.91	6.90
	7.03	6.92	6.95	6.97	6.93	6.94	6.94	6.96	6.94	7.21	7.00	6.89	6.83
	7.01	6.98	6.93	6.99	6.97	6.93	6.92	6.94	6.96	7.16	7.01	6.94	6.87
	7.00	6.92	6.99	7.01	6.99	6.92	6.97	7.01	6.98	7.12	7.01	6.83	6.89
	6.99	6.96	6.99	6.94	6.92	6.93	6.98	7.03	6.91	7.05	7.00	7.01	7.00
	6.99	6.97	6.95	6.97	6.99	7.00	7.00	6.91	7.00	7.19	6.94	6.99	6.98
	6.99	6.98	6.98	6.93	6.98	6.98	6.95	6.95	6.93	7.11	6.96	6.98	6.93
	7.00	6.99	7.00	6.98	6.97	6.99	6.91	6.94	6.97	7.03	6.99	7.00	6.90
	7.01	7.00	6.92	7.00	6.96	6.94	6.96	6.94	6.98	7.10	7.04	6.91	7.02
	7.04	6.98	6.98	6.95	6.95	6.96	6.93	7.02	6.92	6.99	6.95	6.82	6.93
	6.98	6.92	6.91	6.98	6.94	6.92	6.92	7.00	7.00	6.98	6.92	6.86	6.89
	7.01	6.93	7.03	6.98	6.96	6.99	7.01	6.95	6.97	7.13	7.05	7.00	6.88
	6.98	6.96	6.92	6.97	6.98	6.95	6.95	6.99	6.92	7.15	7.02	6.89	7.01
	7.01	6.98	6.91	6.94	7.02	7.01	7.01	6.91	6.91	7.16	7.00	6.85	6.89
	7.02	6.99	6.96	6.96	6.97	6.97	6.98	6.92	7.01	7.18	6.94	6.96	6.91
	7.00	7.00	6.93	6.99	6.92	6.94	6.92	6.94	6.94	7.14	6.97	6.94	6.97
	7.00	6.96	6.92	6.94	6.93	7.03	6.92	6.93	7.02	7.18	6.92	6.88	6.95
	6.99	6.98	6.96	6.96	6.95	6.99	6.93	6.93	6.93	7.03	6.94	6.90	6.98
	7.02	7.01	6.95	6.94	6.95	6.97	6.94	6.99	6.96	7.20	6.93	7.01	6.99
Mean	7.00	6.97	6.95	6.96	6.96	6.96	6.95	6.95	6.95	7.12	6.97	6.92	6.94
CoV	0.002	0.004	0.005	0.004	0.004	0.005	0.005	0.006	0.005	0.011	0.006	0.009	0.008

Table SI 5 Cont.

Specimens	I20S1K0.5	I20S1K1	I20S1K1.5	I20S2K0.5	I20S2K1	I20S2K1.5	I20S3K0.5	I20S3K1	I20S3K1.5
Parallel test results	6.97	6.87	6.87	6.92	6.88	6.95	6.98	6.90	6.89
	6.93	6.90	6.82	6.89	6.90	6.87	6.91	6.94	6.88
	6.92	6.89	6.85	6.93	6.89	6.80	6.85	6.96	6.84
	6.84	6.94	6.81	6.92	6.94	6.79	6.93	6.89	7.00
	6.99	6.90	6.79	6.89	6.96	6.95	6.87	6.83	6.92
	7.00	6.93	6.93	7.00	6.90	6.93	6.84	6.89	6.94
	7.01	6.89	6.96	6.98	6.96	6.97	6.88	6.88	6.99
	6.89	6.86	6.86	6.94	6.91	6.84	6.98	6.84	6.89
	6.94	6.83	6.76	6.94	6.79	6.87	6.92	6.99	6.79
	6.98	6.85	6.81	6.92	6.80	6.82	6.90	7.00	6.84
	6.89	6.89	6.87	6.97	6.92	6.89	6.94	7.01	6.85
	6.90	6.94	6.85	6.93	6.96	6.88	6.98	6.91	6.89
	6.97	7.03	6.79	6.97	6.89	6.83	6.83	6.85	6.87
	6.98	6.91	6.79	6.95	6.94	6.92	6.97	6.82	6.83
	6.91	6.94	6.90	7.00	6.90	6.85	7.00	6.89	6.84
	6.92	6.98	6.89	6.90	6.87	6.83	6.93	6.92	6.82
	6.90	6.97	6.85	6.92	6.91	6.82	6.98	6.94	6.80
	6.87	6.96	6.93	6.99	6.83	6.91	6.99	6.93	6.81
	6.90	6.96	6.86	6.97	6.94	6.80	6.92	6.98	6.79
	6.95	6.84	6.82	6.96	6.91	6.84	6.94	6.95	6.81
Mean	6.93	6.91	6.85	6.94	6.90	6.87	6.93	6.92	6.86
CoV	0.007	0.008	0.008	0.005	0.007	0.008	0.008	0.008	0.009

Table SI 5 Cont.

Specimens	I40S1K0.5	I40S1K1	I40S1K1.5	I40S2K0.5	I40S2K1	I40S2K1.5	I40S3K0.5	I40S3K1	I40S3K1.5
Parallel test results	6.86	6.80	6.81	6.84	6.80	6.78	6.89	6.90	6.84
	6.89	6.83	6.80	6.87	6.81	6.83	6.87	6.91	6.79
	6.79	6.89	6.78	6.89	6.91	6.82	6.90	6.86	6.73
	6.93	6.83	6.79	6.87	6.76	6.82	6.80	6.87	6.74
	6.96	6.89	6.82	6.81	6.81	6.90	6.81	6.81	6.90
	7.00	6.84	6.85	6.80	6.80	6.83	6.79	6.76	6.82
	6.78	6.87	6.88	6.94	6.82	6.78	6.91	6.89	6.86
	6.86	6.88	6.75	6.84	6.85	6.90	6.92	6.73	6.87
	6.83	6.81	6.79	6.93	6.88	6.79	6.94	6.89	6.83
	6.90	6.85	6.83	6.90	6.94	6.85	6.72	6.84	6.82
	6.86	6.87	6.84	6.95	6.98	6.82	6.93	6.75	6.80
	6.81	6.89	6.88	6.83	6.79	6.85	6.99	6.83	6.91
	6.83	6.90	6.82	6.91	6.72	6.89	6.86	6.89	6.77
	6.87	6.81	6.76	6.99	6.89	6.84	6.89	6.82	6.80
	6.88	6.84	6.75	6.83	6.77	6.81	6.97	6.84	6.83
	6.81	6.82	6.82	6.80	6.80	6.91	6.96	6.80	6.89
	6.92	6.89	6.84	6.82	6.93	6.78	6.92	6.86	6.83
	6.88	6.84	6.90	6.93	6.91	6.82	6.82	6.86	6.84
	6.85	6.81	6.78	6.91	6.87	6.74	6.80	6.94	6.80
	6.91	6.87	6.71	6.89	6.83	6.73	6.76	6.94	6.81
Mean	6.87	6.85	6.81	6.88	6.84	6.82	6.87	6.85	6.82
CoV	0.008	0.005	0.007	0.008	0.010	0.007	0.011	0.009	0.007

Table SI 5 Cont.

Specimens	I20S2K1T40	I20S2K1T60	I20S2K1T75	I40S2K1T40	I40S2K1T60	I40S2K1T75
Parallel test results	7.01	7.04	7.00	7.09	6.89	6.96
	7.00	6.97	7.02	6.99	6.91	7.06
	6.98	6.95	7.03	6.98	6.97	7.05
	6.93	7.01	6.99	7.01	7.08	6.93
	6.96	7.00	6.91	7.04	6.93	6.97
	6.99	6.99	6.97	7.03	6.99	6.92
	7.05	6.98	7.02	6.93	7.01	7.00
	6.92	7.02	7.01	6.95	7.00	6.96
	7.03	7.03	6.97	6.97	6.96	7.01
	7.01	6.94	6.94	7.06	6.97	6.92
	7.00	6.97	7.04	7.02	6.94	6.94
	6.91	7.06	7.03	7.00	7.05	7.02
	6.99	7.04	7.00	6.97	7.03	6.99
	6.91	6.95	6.91	6.99	7.05	7.04
	6.90	7.03	6.94	6.93	6.98	7.03
	6.99	7.01	6.98	7.02	6.92	7.01
	7.05	7.00	7.01	6.92	6.94	7.03
	7.03	7.00	6.97	7.01	7.07	7.10
	7.03	6.99	7.02	7.04	7.02	6.91
	7.01	7.00	6.95	7.03	6.98	7.00
Mean	6.99	7.00	6.99	7.00	6.98	6.99
CoV	0.007	0.005	0.006	0.006	0.008	0.008

Table SI 6 Experimental results of interfacial shear strength (IFSS) tests

Specimens	VCF	I20S1K0.5	I20S1K1	I20S1K1.5	I20S2K0.5	I20S2K1	I20S2K1.5	I20S3K0.5	I20S3K1	I20S3K1.5	I40S2K0.5
Parallel test results	28.84	29.65	33.43	32.65	29.10	37.20	33.28	28.61	34.27	33.26	28.06
	33.21	30.06	32.79	32.49	29.90	37.45	32.81	28.43	34.58	33.54	26.35
	31.18	29.13	34.17	33.15	30.31	37.62	33.06	29.44	33.35	34.15	26.62
	30.76	29.34	34.01	31.79	28.90	37.25	32.61	27.77	33.57	34.54	27.18
	31.02	30.22	33.05	33.72	29.34	37.62	33.57	29.87	34.49	32.74	26.81
Mean	31.00	29.69	33.48	32.76	29.50	37.43	33.06	28.83	34.06	33.65	27.00
CoV	0.050	0.016	0.018	0.022	0.020	0.005	0.011	0.029	0.016	0.021	0.025

Specimens	I40S2K1	I40S2K1.5	I40S3K0.5	I40S3K1	I40S3K1.5	I20S2K1T40	I20S2K1T60	I20S2K1T75	I40S2K1T40	I40S2K1T60	I40S2K1T75
Parallel test results	26.63	24.42	25.83	28.08	24.33	26.49	33.65	33.52	24.29	29.51	35.89
	29.07	25.14	26.85	28.65	25.38	24.76	33.52	34.52	25.49	31.56	34.97
	28.50	24.54	26.92	28.27	25.93	25.00	33.61	33.11	23.17	29.16	36.51
	28.15	23.80	25.10	26.90	24.13	26.71	31.98	32.79	26.04	28.06	34.24
	28.07	25.63	27.90	29.83	26.21	24.21	35.21	34.66	24.07	30.84	37.34
Mean	28.08	24.70	26.53	28.33	25.20	25.42	33.59	33.72	24.61	29.84	35.79
CoV	0.032	0.028	0.041	0.037	0.037	0.043	0.034	0.025	0.047	0.046	0.034

Table SI 7 Experimental results of surface roughness

Specimens	VCF	I20S1K0.5	I20S1K1	I20S1K1.5	I20S2K0.5	I20S2K1	I20S2K1.5	I20S3K0.5	I20S3K1	I20S3K1.5
Parallel test results	200	192	209	202	192	219	215	196	209	208
	204	194	213	201	195	221	206	191	206	199
	198	196	217	205	192	228	221	193	205	205
	197	189	218	210	199	221	201	194	216	200
	204	198	214	200	201	225	204	185	207	208
	201	192	210	212	197	226	213	186	209	203
	204	194	221	206	189	214	204	198	207	206
	202	198	216	207	192	216	223	189	210	199
	201	200	206	201	195	220	206	197	214	198
	198	193	210	208	196	219	216	198	217	205
	199	192	207	211	203	226	215	196	209	208
	197	194	205	206	189	223	210	200	208	197
	201	193	218	204	188	211	222	197	211	198
	198	195	216	210	199	206	212	194	204	204
	204	197	207	208	193	209	217	190	207	201
	205	197	222	201	202	219	208	194	211	200
	203	201	213	202	198	218	217	197	210	201
	198	200	214	205	201	217	218	185	206	205
	199	196	216	208	194	215	207	184	209	207
	203	198	218	201	198	222	216	186	208	206
Mean	201	195	214	205	196	219	213	193	209	203
CoV	0.013	0.016	0.023	0.018	0.023	0.026	0.030	0.027	0.016	0.018

Table SI 7 Cont.

Specimens	I40S2K0.5	I40S2K1	I40S2K1.5	I40S3K0.5	I40S3K1	I40S3K1.5
Parallel test results	187	195	173	186	193	178
	186	201	172	184	200	179
	186	198	181	189	193	180
	190	199	170	193	196	179
	191	201	172	198	194	180
	186	196	182	193	198	172
	182	206	171	186	203	175
	183	199	171	188	192	179
	187	202	180	187	193	180
	182	196	174	195	197	182
	186	195	182	186	206	184
	189	203	169	193	199	179
	184	205	181	191	204	182
	189	192	170	189	194	174
	185	198	172	182	195	171
	189	200	184	196	198	172
	182	206	180	183	195	181
	179	198	170	192	199	179
	183	204	176	185	201	180
	179	194	176	193	198	174
Mean	185	199	175	189	197	178
CoV	0.019	0.021	0.029	0.024	0.020	0.021

Table SI 7 Cont.

Specimens	I20S2K1T40	I20S2K1T60	I20S2K1T75	I40S2K1T40	I40S2K1T60	I40S2K1T75
Parallel test results	192	201	211	198	201	210
	197	205	213	194	193	209
	189	197	205	200	200	216
	194	210	215	196	193	208
	184	200	204	191	205	213
	193	208	205	194	195	206
	187	203	216	195	210	218
	194	201	203	189	193	216
	189	201	204	202	192	213
	185	198	213	196	204	215
	186	205	205	188	192	206
	198	200	205	189	205	214
	185	199	214	197	195	203
	197	203	208	201	203	215
	184	201	203	198	193	204
	194	206	201	196	203	211
	189	201	207	197	194	201
	188	203	204	201	207	210
	183	207	211	192	201	215
	189	202	210	194	195	208
Mean	190	203	208	195	199	211
CoV	0.025	0.017	0.022	0.021	0.029	0.023