Supplemental Material

Electrical Properties of Iron Sulfide-bearing Dunite under Pressure: Effect of Temperature, Composition, and Annealing Time

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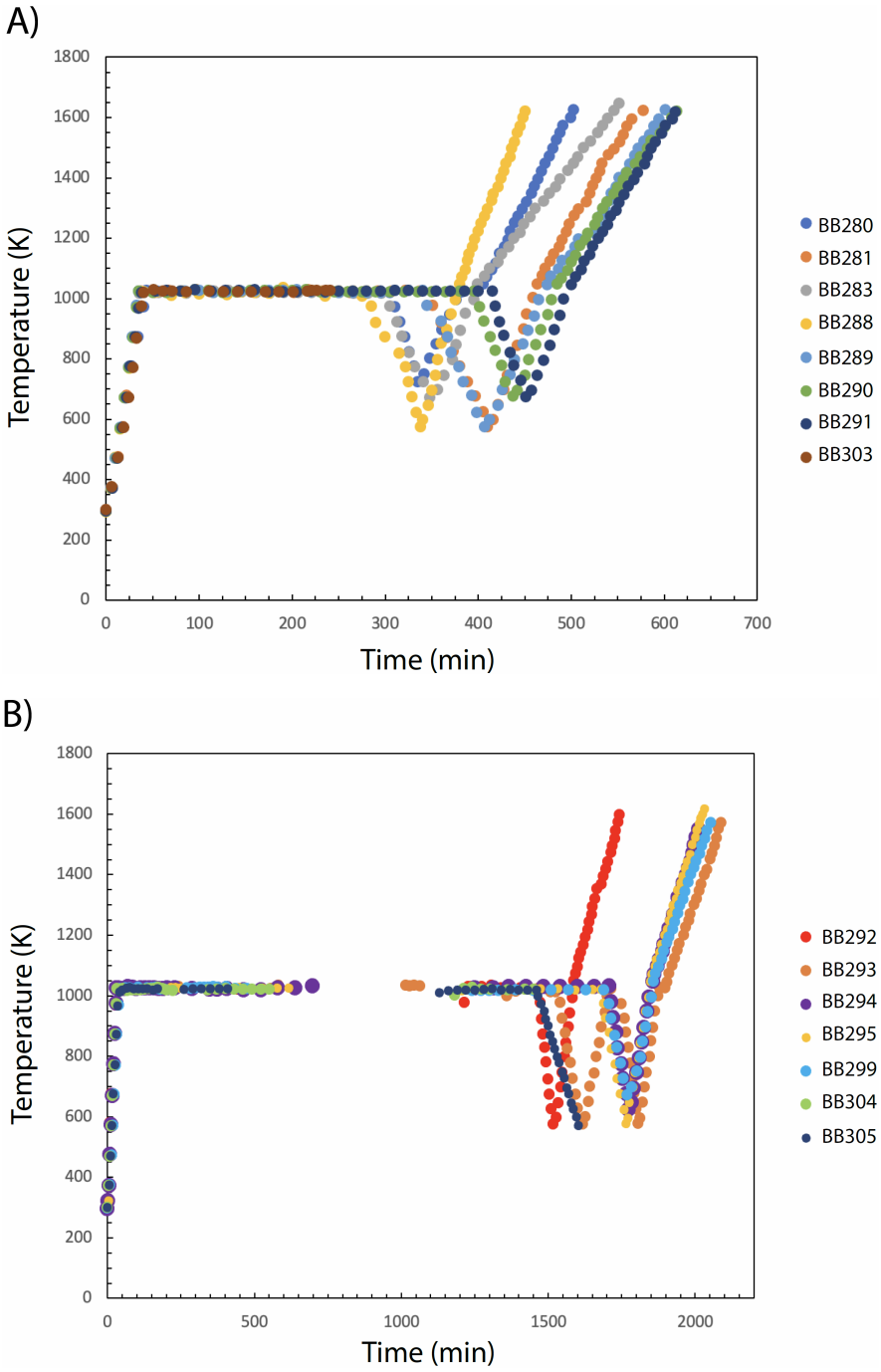
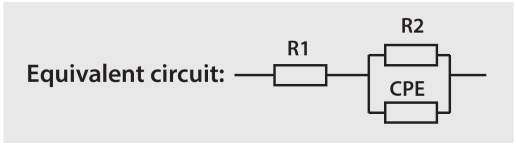
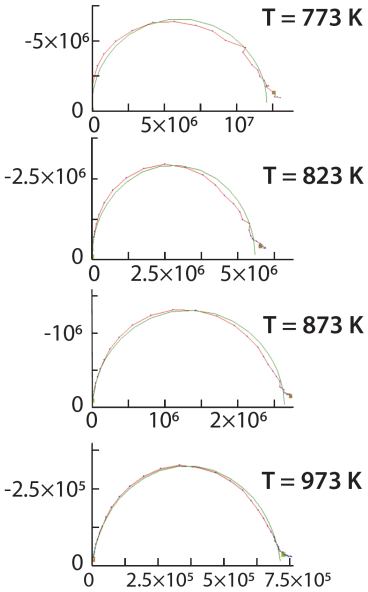


Figure S1: Temperature versus time for experiments with annealing times (A) shorter than 6 hours, or (B) longer than 23 hours. Note that zero-time in these graphs refers to the beginning of heating, whereas zero-time in graphs of **Figure 3** marks when the sample first reached 1023 K, an offset of approximately 40 minutes. For information about composition, see **Table 1**.



BB283, Z″=f(Z′), Z″ and Z′ in Ω



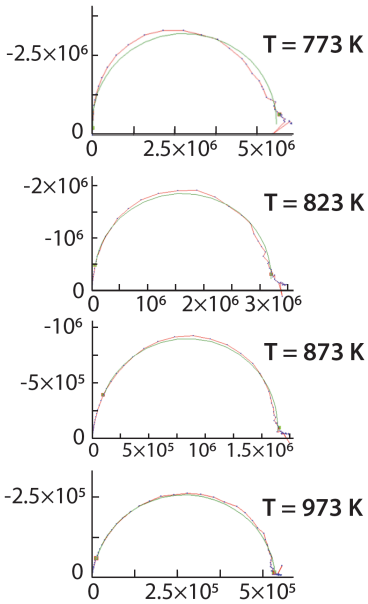
Element	Value	Error	Error (%)
R1 (Ohm)	18,483	2530	13.7
R2 (Ohm)	$1.2x10^{7}$	$1.5x10^{5}$	1.25
CPE-T	$9.3x10^{-12}$	$4.9x10^{-13}$	5.30
CPE-P	1.05	0.005	0.45

Element	Value	Error	Error (%)
R1 (Ohm)	14,135	1877	13.3
R2 (Ohm)	$5.6x10^{6}$	$4.5x10^{4}$	0.81
CPE-T	$1.3x10^{-11}$	$6.0x10^{-13}$	4.62
CPE-P	1.03	0.004	0.40

Element	Value	Error	Error (%)
R1 (Ohm)	9,260	1408	15.2
R2 (Ohm)	$2.6x10^{6}$	$1.4x10^{4}$	0.53
CPE-T	$1.9x10^{-11}$	$7.6x10^{-13}$	4.08
CPE-P	1.00	0.003	0.36

Element	Value	Error	Error (%)
R1 (Ohm)	495	218	44.2
R2 (Ohm)	$7.2x10^{5}$	2678	0.37
CPE-T	$4.1x10^{-11}$	$1.2x10^{-12}$	2.93
CPE-P	0.94	0.002	0.24

BB295, Z″=f(Z′), Z″ and Z′ in Ω



Element	Value	Error	Error (%)
R1 (Ohm)	43,595	4,814	11.0
R2 (Ohm)	$5.5x10^{6}$	$5.0x10^{4}$	0.91
CPE-T	$6.4x10^{-12}$	$3.5x10^{-13}$	5.44
CPE-P	1.10	0.005	0.46

Element	Value	Error	Error (%)
R1 (Ohm)	71,086	6,822	9.6
R2 (Ohm)	$3.1x10^{6}$	$1.9x10^{4}$	0.61
CPE-T	$5.8x10^{-12}$	$2.8x10^{-13}$	4.85
CPE-P	1.11	0.005	0.43

Element	Value	Error	Error (%)
R1 (Ohm)	54,461	4,770	8.76
R2 (Ohm)	$1.6x10^{6}$	8165	0.51
CPE-T	$7.9x10^{-12}$	$3.7x10^{-13}$	4.59
CPE-P	1.08	0.005	0.42

Element	Value	Error	Error (%)
R1 (Ohm)	5,341	504	9.43
R2 (Ohm)	$5.3x10^{5}$	1496	0.28
CPE-T	$2.5x10^{-11}$	$7.7x10^{-13}$	3.01
CPE-P	0.98	0.003	0.26

Figure S2: Representative fits to complex impedance arcs (Nyquist plots), showing an equivalent electrical circuit and examples of fitting for experiments BB283 and BB295. Impedance spectra are shown for different temperatures. Measurements correspond to the red lines, and fits are green. For each spectrum, the table shows the value and error for each element of the circuit. CPE: constant phase element. CPE-T: pseudo capacitance; CPE-P: exponent related to the semi-circle in the Nyquist plot.

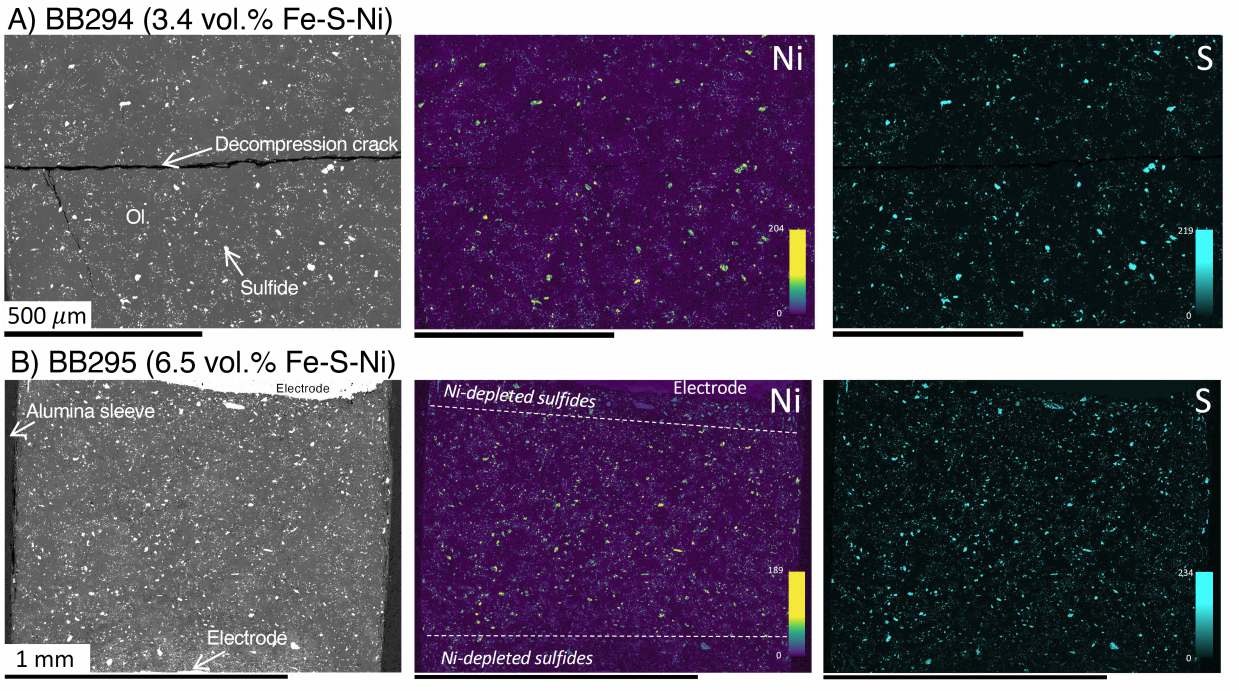


Figure S3: Back-scattered electron (BSE) images (left panels) and wavelength dispersive spectroscopy (WDS) maps for Ni (middle panels) and S (right panels) for samples BB294 and BB295. Numbers on the scale bars indicate counts.

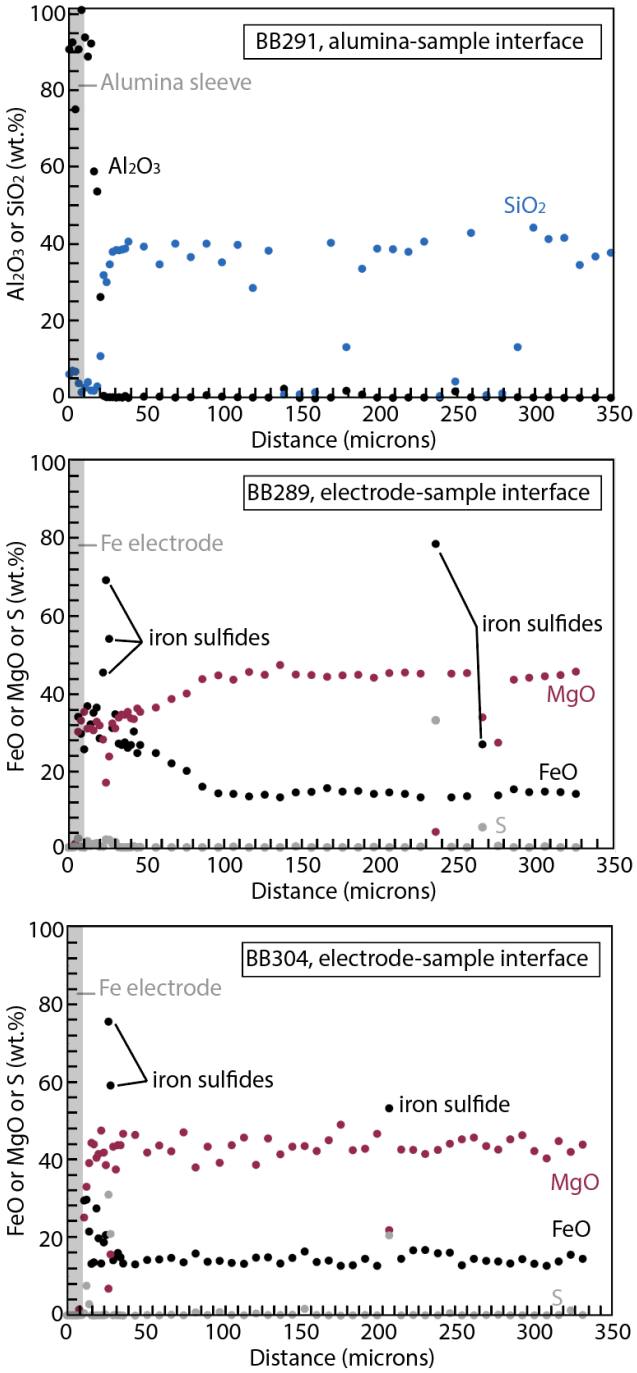
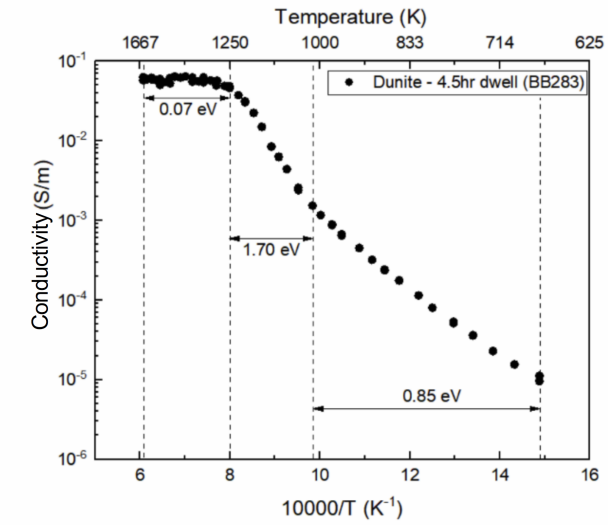
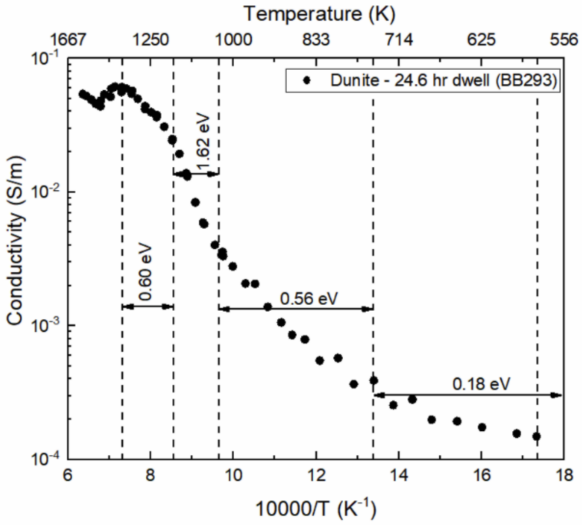


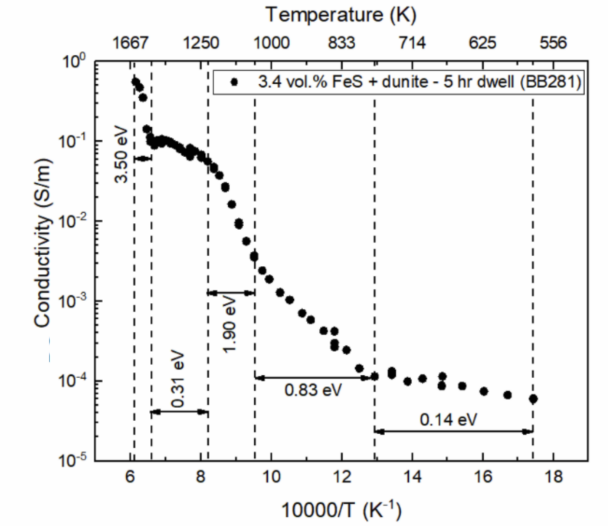
Figure S4: Electron microprobe profiles at the alumina sleeve-sample interface (sample BB291, 18.2 vol.% FeS) and the Fe electrode-sample interface (samples BB289, 6.5 vol.% FeS, quenched at 1627 K, and BB304, 3.4 vol.% FeS, quenched at 1023 K). Diffusion of Al into the sample at elevated temperature forms an Al-rich thin layer at the alumina-sample interface that is less than 30 microns thick. Interactions between the Fe electrode disk and the sample are minimal, with Fe contamination observed within 30-80 microns of the electrode disks, depending on the quenching temperature.

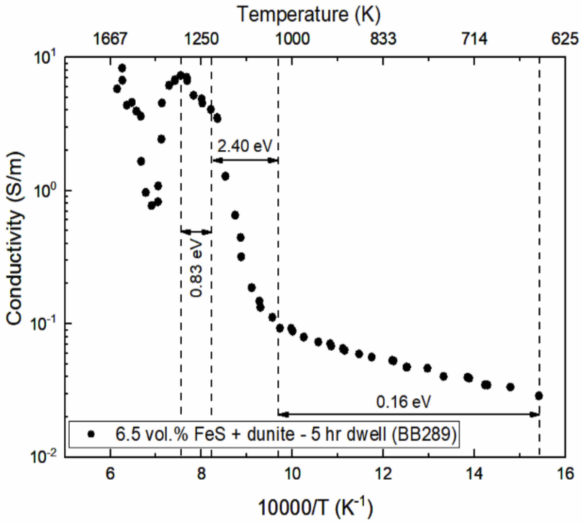
Dunite:

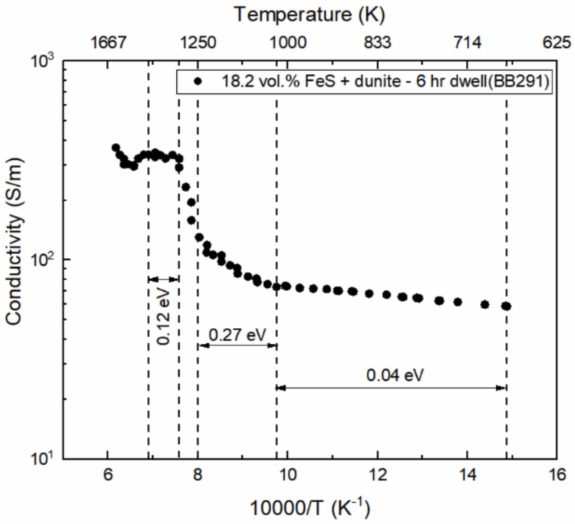


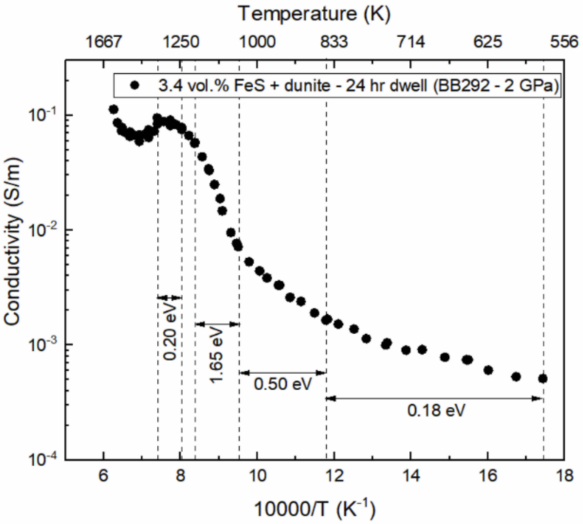


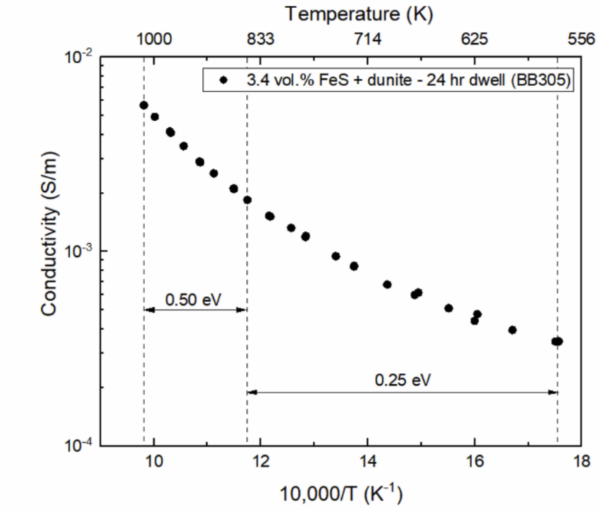
FeS + dunite:











Fe-S-Ni + dunite:

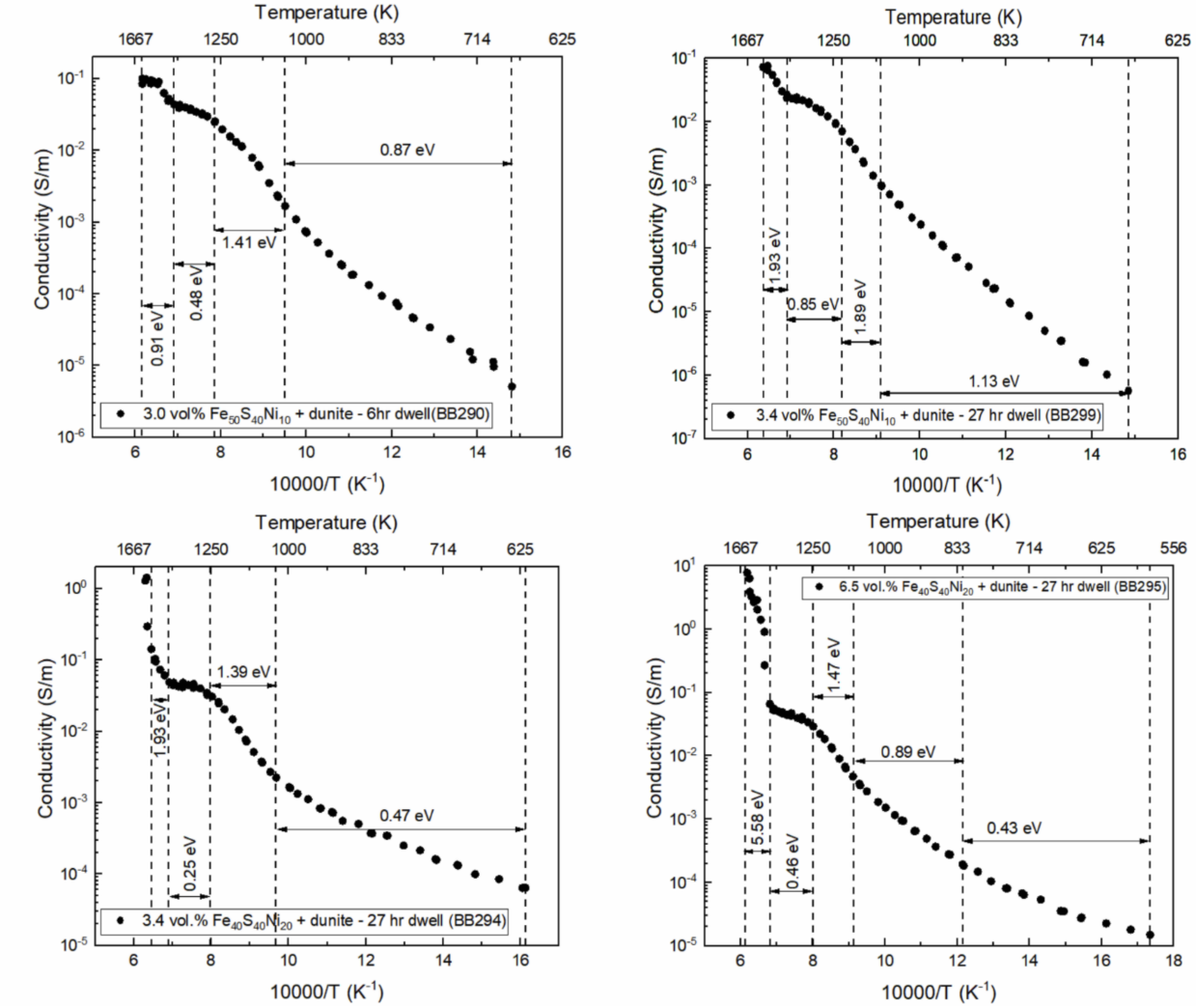


Figure S5: Conductivity (extrapolated to DC) as a function of inverse temperature, showing (apparent) activation energy values for each experiment. See main text for details.