SUPPLEMENTARY MATERIAL

TABLE I
Parameters' values used for training dataset creation

Parameter	Value
d_p,μm	150, 180, 210, 240 (4 values)
N_B,cm^{-3}	10^{15} , 1.778×10^{15}, 3.162×10^{15}, 5.623×10^{15}, 10^{16} , 1.778×10^{16}, 3.162×10^{16}, 5.623×10^{16}, 10^{17} (9 values)
N_{Fe},cm^{-3}	10^{10}, 1.468×10^{10}, 2.154×10^{10}, 3.162×10^{10}, 4.642×10^{10}, 6.813×10^{10}, 10^{11}, 1.468×10^{11}, 2.154×10^{11}, 3.162×10^{11}, 4.642×10^{11}, 6.813×10^{11}, 10^{12}, 1.468×10^{12}, 2.154×10^{12}, 3.162×10^{12}, 4.642×10^{12}, 6.813×10^{12}, 10^{13} (19 values)
T, K	290, 295,300, 305, 310, 315, 320, 325, 330, 335, 340 (11 values)
# of IV pair	$4 \times 9 \times 19 \times 11 = 7524$

TABLE II
Parameters' values used for test dataset creation

N_B,cm^{-3}	N_{Fe},cm^{-3}	d_p,μm	T, K	# of IV pair
B-varied dataset				
1.4×10^{15} (1 value)	10^{10}, 1.468×10^{10}, 2.154×10^{10}, 3.162×10^{10}, 4.642×10^{10}, 6.813×10^{10}, 10^{11}, 1.468×10^{11}, 2.154×10^{11}, 3.162×10^{11}, 4.642×10^{11}, 6.813×10^{11}, 10^{12}, 1.468×10^{12}, 2.154×10^{12}, 3.162×10^{12}, 4.642×10^{12}, 6.813×10^{12}, 10^{13} (19 values)	150, 180 (2 values)	290, 295, 300, 305, 310, 315, 320, 325, 330, 335, 340 (11 values)	1×19×2×11= 418

4.5×10^{15} , 8×10^{16} (2 values)	10^{10}, 2.154×10^{10}, 3.162×10^{10}, 1.468×10^{11}, 2.154×10^{11}, 4.642×10^{11}, 10^{12}, 2.154×10^{12}, 3.162×10^{12}, 4.642×10^{12}, 6.813×10^{12}, 10^{13} (12 values)	210 (1 value)	290, 305, 320, 340 (4 values)	$2\times12\times1\times4 = 96$
				$96 + 418 = 514$
Fe-varied dataset				
1.778×10^{15}, 5.623×10^{15}, 10^{16} , 3.162×10^{16}, 10^{17} (5 values)	1.3×10^{10}, 2.471×10^{10}, 4.696×10^{10}, 8.927×10^{10}, 1.697×10^{11}, 3.225×10^{11}, 6.13×10^{11}, 1.165×10^{12}, 2.214×10^{12}, 4.209×10^{12}, 8×10^{12} (11 values)	180 (1 value)	290, 295, 300, 305, 310, 315, 320, 325, 330, 335, 340 (11 values)	$5\times11\times1\times11 = 605$
3.162×10^{15}, 10^{16} , 10^{17} (3 values)	1.2×10^{11}, 2.234×10^{11}, 4.16×10^{11}, 7.746×10^{11}, 1.442×10^{12}, 2.685×10^{12}, 5×10^{12} (7 values)	210, 240 (2 values)	290, 300, 310, 320, 330, 340 (6 values)	$3\times7\times2\times6 = 252$
				$605 + 252 = 857$

d-varied dataset				
10^{15} , 5.623×10^{15}, 1.778×10^{16}, 5.623×10^{16} (4 values)	10^{10}, 1.468×10^{10}, 2.154×10^{10}, 3.162×10^{10}, 4.642×10^{10}, 6.813×10^{10}, 10^{11}, 1.468×10^{11}, 2.154×10^{11}, 3.162×10^{11}, 4.642×10^{11}, 6.813×10^{11}, 10^{12}, 1.468×10^{12}, 2.154×10^{12}, 3.162×10^{12}, 4.642×10^{12}, 6.813×10^{12}, 10^{13} (19 values)	190 (1 value)	290, 300, 310, 320, 330, 340 (6 values)	4×19×1×6 = 456
10^{15} , 1.778×10^{15}, 3.162×10^{15}, 5.623×10^{15}, 10^{16} , 1.778×10^{16}, 3.162×10^{16}, 5.623×10^{16}, 10^{17} (9 values)	10^{10}, 3.162×10^{10}, 10^{11}, 3.162×10^{11}, 10^{12}, 3.162×10^{12}, 10^{13} (7 values)	205 (1 value)	295, 305, 315, 325, 335 (5 values)	9×7×1×5 = 315
1.778×10^{15}, 10^{16} (2 values)	10^{10}, 1.468×10^{10}, 2.154×10^{10}, 3.162×10^{10}, 4.642×10^{10}, 6.813×10^{10}, 10^{11}, 1.468×10^{11}, 2.154×10^{11}, 3.162×10^{11}, 4.642×10^{11}, 6.813×10^{11}, 10^{12}, 1.468×10^{12}, 2.154×10^{12}, 3.162×10^{12}, 4.642×10^{12}, 6.813×10^{12}, 10^{13} (19 values)	230 (1 value)	290, 295, 300, 305, 310, 315, 320, 325, 330, 335, 340 (11 values)	2×19×1×11 = 418
				456+315+418 = 1189

T-varied dataset				
10^{15} , 1.778×10^{15}, 3.162×10^{15}, 5.623×10^{15}, 10^{16} , 1.778×10^{16}, 3.162×10^{16}, 5.623×10^{16}, 10^{17} (9 values)	1.468×10^{10}, 4.642×10^{10}, 6.813×10^{10}, 1.468×10^{11}, 4.642×10^{11}, 6.813×10^{11}, 2.154×10^{12}, 4.642×10^{12} (8 values)	210 (1 value)	314 (1 value)	9×8×1×1 = 72
10^{15} , 5.623×10^{15}, 1.778×10^{16}, 3.162×10^{16} (4 values)	10^{10}, 1.468×10^{10}, 2.154×10^{10}, 3.162×10^{10}, 4.642×10^{10}, 6.813×10^{10}, 10^{11}, 1.468×10^{11}, 2.154×10^{11}, 3.162×10^{11}, 4.642×10^{11}, 6.813×10^{11}, 10^{12}, 1.468×10^{12}, 2.154×10^{12}, 3.162×10^{12}, 4.642×10^{12}, 6.813×10^{12}, 10^{13} (19 values)	150, 180, 210, 240 (4 values)	303 (1 value)	4×19×4×1 = 304
1.778×10^{15}, 1.778×10^{16}, 10^{17} (3 values)		150, 180 (2 values)	293 (1 value)	3×19×2×1 = 114
10^{15} , 1.778×10^{15}, 3.162×10^{15}, 5.623×10^{15}, 10^{16} , 1.778×10^{16}, 3.162×10^{16}, 5.623×10^{16}, 10^{17} (9 values)		180, 240 (2 values)	336 (1 value)	9×19×2×1 = 342
				72+304+114 +342 = 832

All-varied dataset				
1.3×10^{15} , 2×10^{16} (2 values)	5×10^{12}, 6.082×10^{12}, 7.399×10^{12}, 9×10^{12} (4 values)	200 (1 value)	293, 313, 333 (3 values)	2×4×1×3 = 24
7×10^{15} , 4.5×10^{16} (2 values)	5×10^{10}, 5.861×10^{10}, 6.869×10^{10}, 8.051×10^{10}, 9.437×10^{10}, 1.106×10^{11}, 1.296×10^{11}, 1.52×10^{11}, 1.781×10^{11}, 2.088×10^{11}, 2.447×10^{11}, 2.868×10^{11}, 3.362×10^{11}, 3.94×10^{11}, 4.618×10^{11}, 5.413×10^{11}, 6.345×10^{11}, 7.437×10^{11}, 8.717×10^{11}, 1.022×10^{12}, 1.198×10^{12}, 1.404×10^{12}, 1.645×10^{12}, 1.928×10^{12}, 2.26×10^{12}, 2.649×10^{12}, 3.105×10^{12}, 3.639×10^{12}, 4.266×10^{12}, 5×10^{12} (30 values)	170, 200 (2 values)	297, 309, 321, 333 (4 values)	2×30×2×4 = 480

2.5×10^{15} , 8×10^{16} (2 values)	1.1×10^{10}, 1.302×10^{10}, 1.54×10^{10}, 1.822×10^{10}, 2.156×10^{10}, 2.551×10^{10}, 3.018×10^{10}, 3.571×10^{10}, 4.226×10^{10}, 5×10^{10}, 1.1×10^{11}, 1.302×10^{11}, 1.54×10^{11}, 1.822×10^{11}, 2.156×10^{11}, 2.551×10^{11}, 3.018×10^{11}, 3.571×10^{11}, 4.226×10^{11}, 5×10^{11},1.1×10^{12}, 1.302×10^{12}, 1.54×10^{12}, 1.822×10^{12}, 2.156×10^{12}, 2.551×10^{12}, 3.018×10^{12}, 3.571×10^{12}, 4.226×10^{12}, 5×10^{12} (30 values)	220 (1 values)	292, 302, 312 (3 values)	2×30×1×3 = 180
				24+480+180 = 684

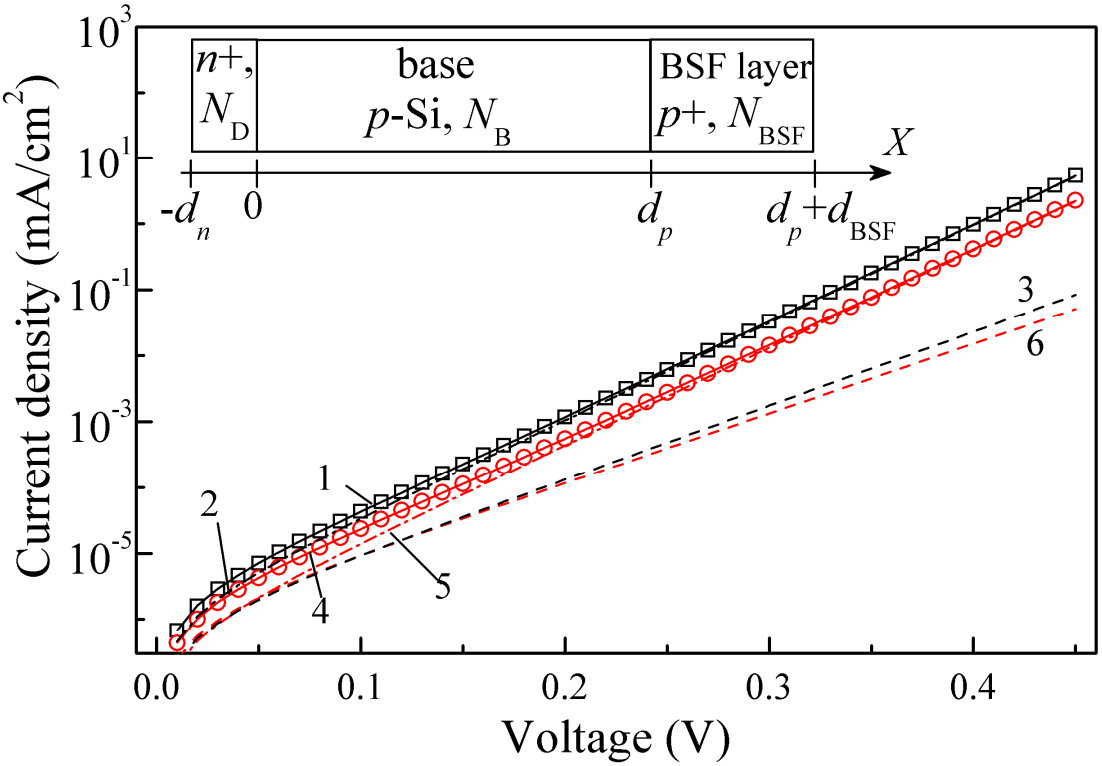

FIGURE 1S. Simulated IV characteristic (marks) and its fitting by Eq. (10) (solid lines 1 and 4). The dashed (3, 6) and dotted-dashed (2, 5) lines represent the recombination diode currents and the "ideal"' diode currents, respectively. $N_B = 10^{17}$ cm^{-3} , $N_{Fe} = 10^{13}$ cm^{-3} , $T = 340$ K, $d_p = 180$ μm. The results for "Fe"-case (circles, curves 4-6, red) and "Fe-FeB" case (squares, curves 1-3, black) are presented.

Inset: Solar cell structure, which are used in the simulation

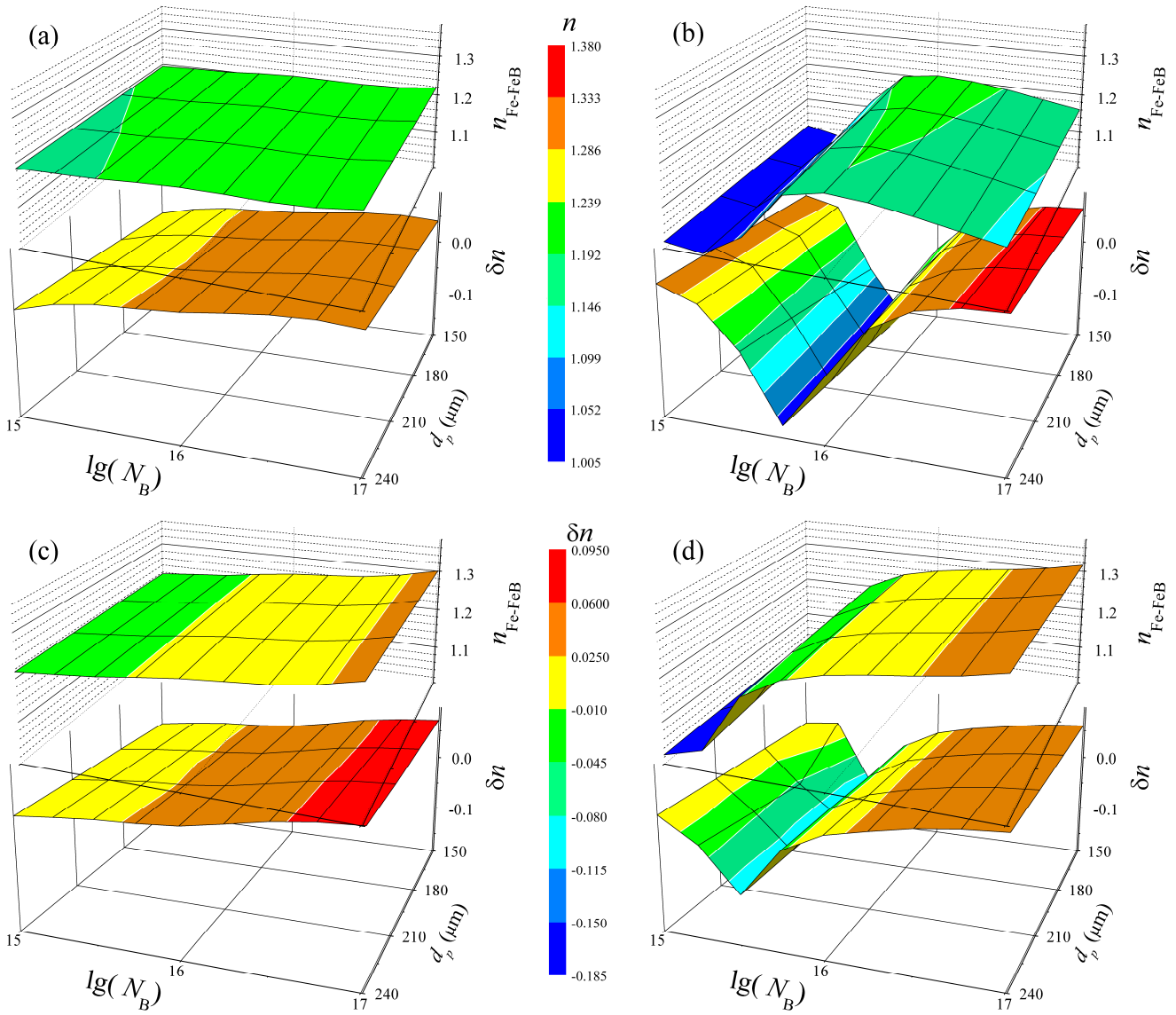

FIGURE 2S. Dependencies of ideality factor in Fe-FeB case (upper parts) and $\delta n = n_{\text{Fe}}\text{-}n_{\text{Fe-FeB}}$ on doping level and base depth. N_{Fe}, cm^{-3}: 10^{10} (a,b), 10^{13} (c,d); T, K: 290 (a,c), 340 (b,d)

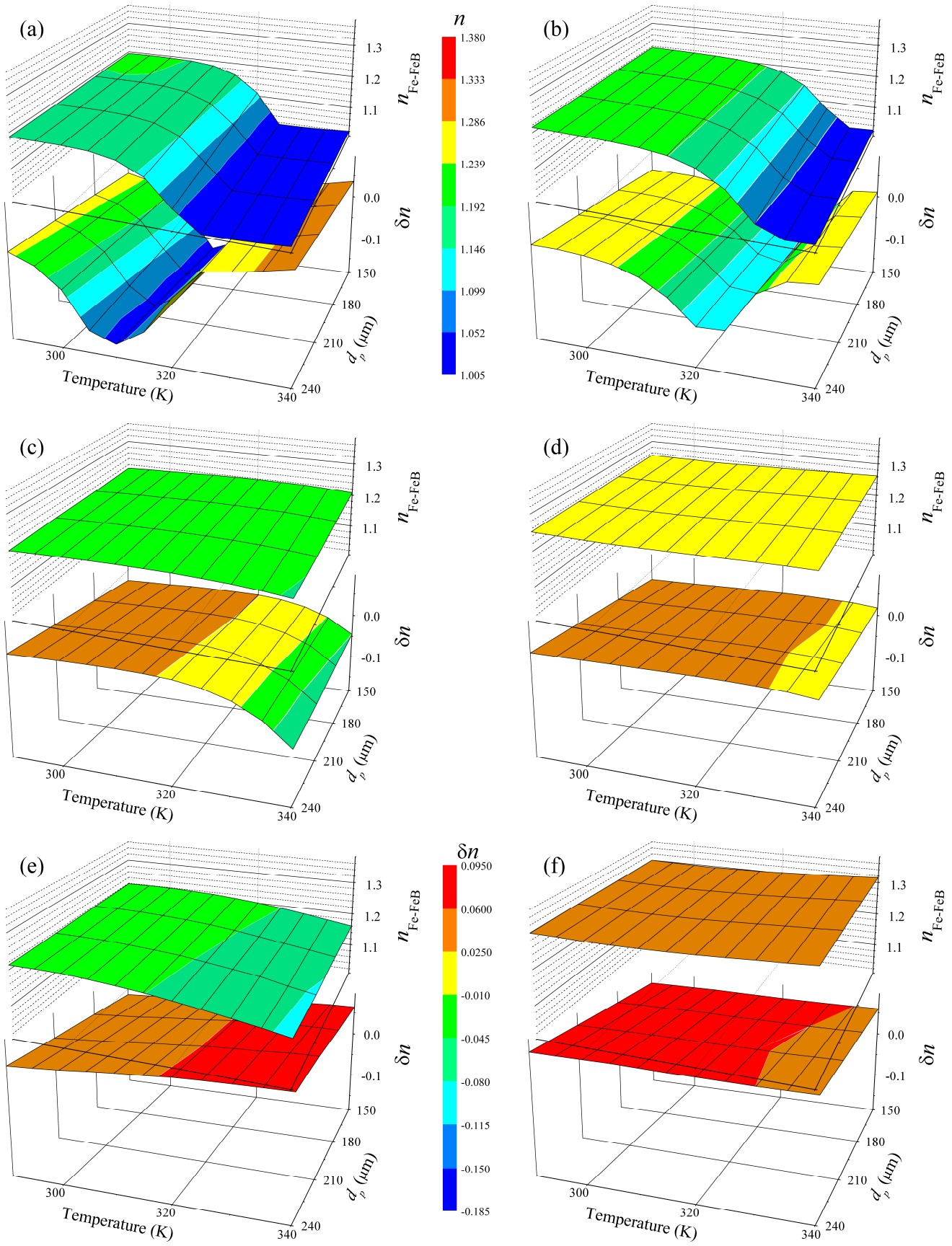

FIGURE 3S. Dependencies of ideality factor in Fe-FeB case (upper parts) and $\delta n = n_{Fe}$-$n_{Fe\text{-}FeB}$ on temperature and base depth. N_{Fe}, cm^{-3}: 10^{10} (a,c,e), 10^{13} (b,d,f); N_A, cm^{-3}: 10^{15} (a,b), 10^{16} (c,d) , 10^{17} (e,f).

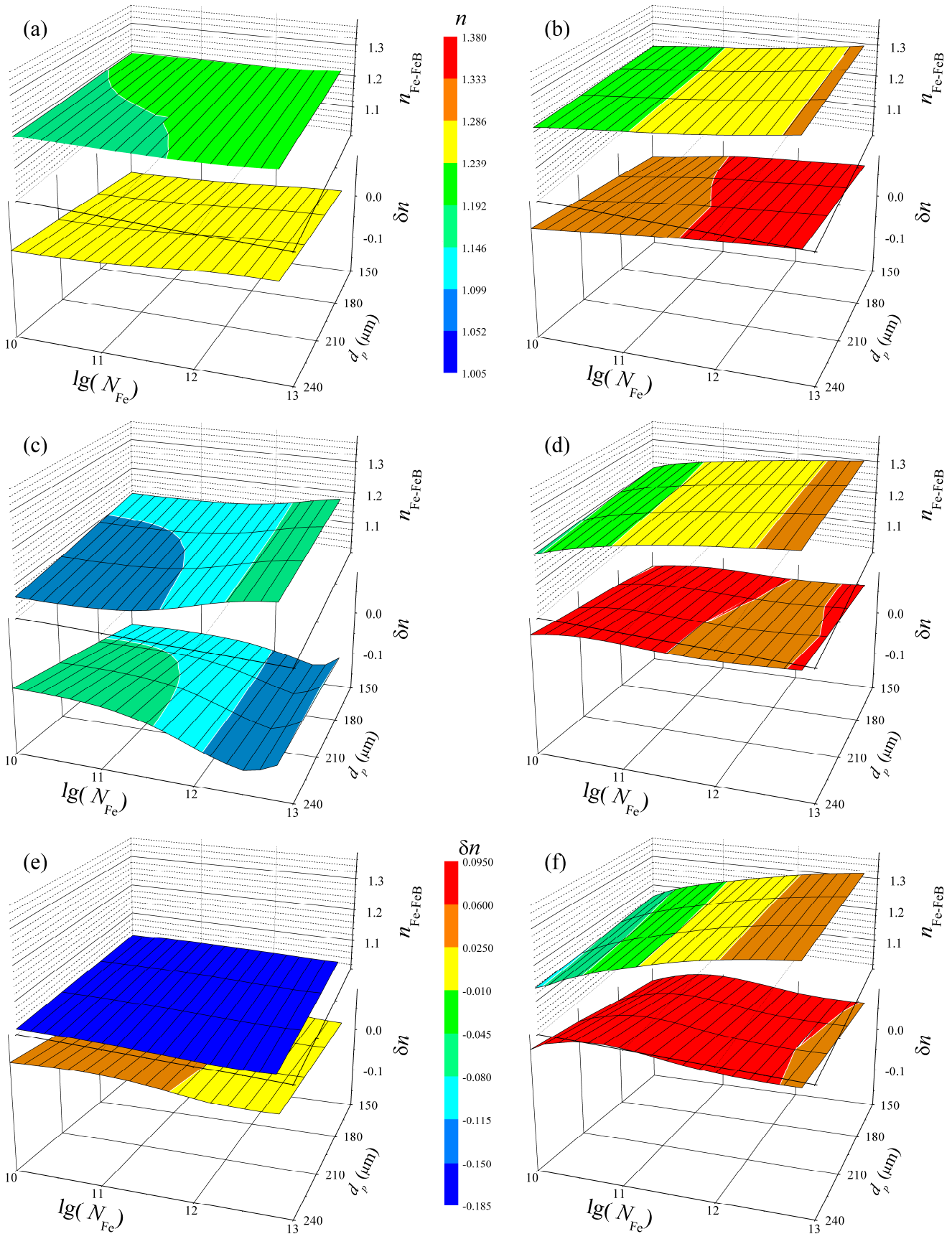

FIGURE 4S. Dependencies of ideality factor in Fe-FeB case (upper parts) and $\delta n = n_{\text{Fe}}\text{-}n_{\text{Fe-FeB}}$ on iron concentration and base depth. N_B, cm^{-3}: 10^{15} (a,c,e), 10^{17} (b,d,f); T, K: 290 (a,b), 320 (c,d) , 340 (e,f).

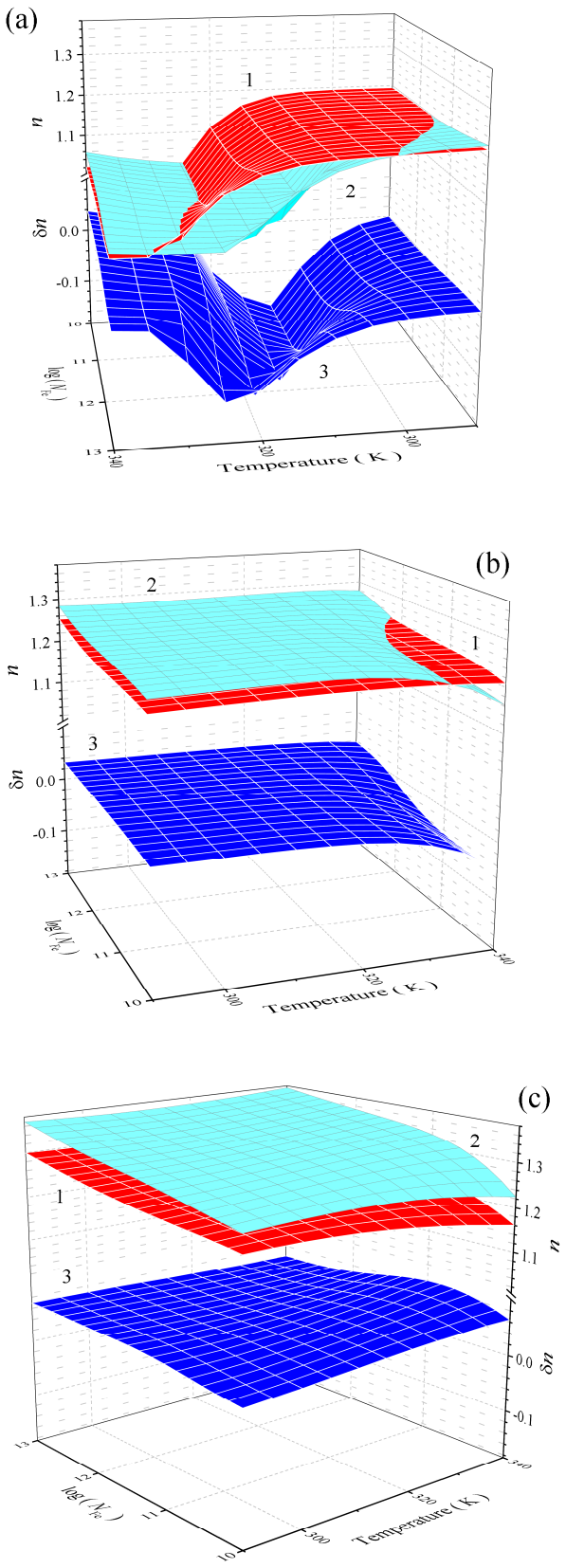

FIGURE 5S. Ideality factor and its change as a function of the temperature and iron concentration. N_B, cm^{-3}: 10^{15} (a), 10^{16} (b), 10^{17} (c); d_p = 150 μm. Surface 1 (red) correspond to $n_{Fe\text{-}FeB}$ dependance, 2 (cyan) - n_{Fe}, 3 (blue) - $\delta n = n_{Fe}$-$n_{Fe\text{-}FeB}$

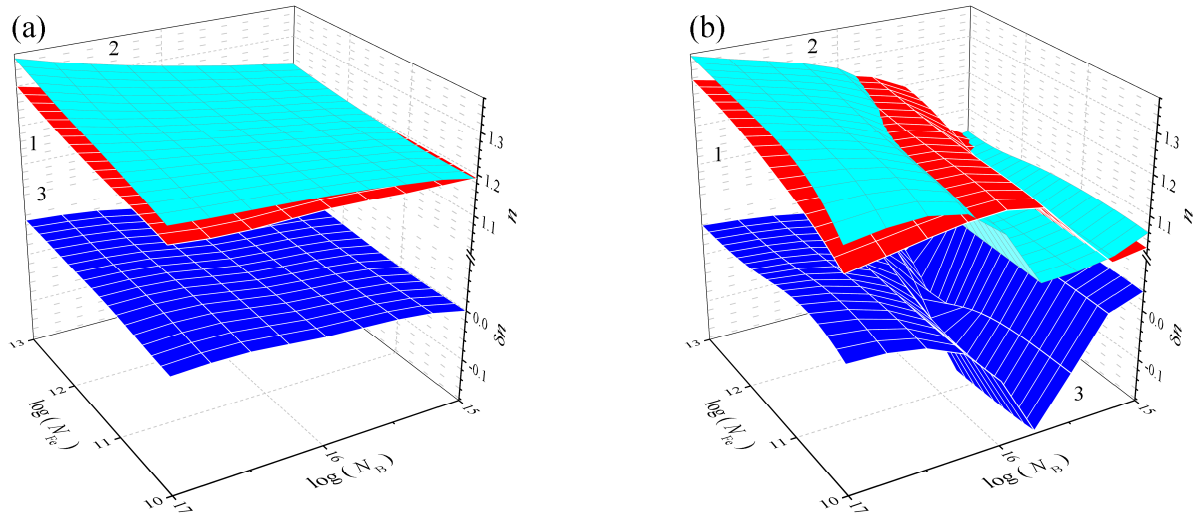

FIGURE 6S. Ideality factor and its change as a function of the boron concentration and iron concentration. T, K: 290 (a), 340 (b); d_p = 180 μm. Surface 1 (red) correspond to $n_{Fe\text{-}FeB}$ dependance, 2 (cyan) - n_{Fe}, 3 (blue) - $\delta n = n_{Fe}$-$n_{Fe\text{-}FeB}$

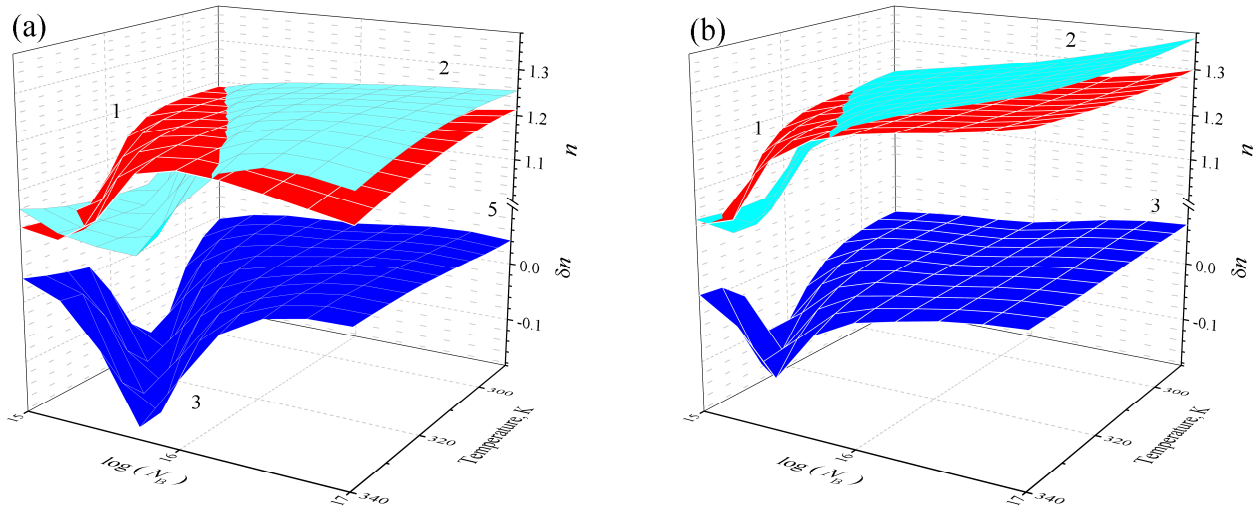

FIGURE 7S. Ideality factor and its change as a function of the boron concentration and temperature. N_{Fe}, cm^{-3}: 10^{10} (a), 10^{13} (b); d_p = 240 μm. Surface 1 (red) correspond to $n_{Fe\text{-}FeB}$ dependance, 2 (cyan) - n_{Fe}, 3 (blue) - $\delta n = n_{Fe}$-$n_{Fe\text{-}FeB}$

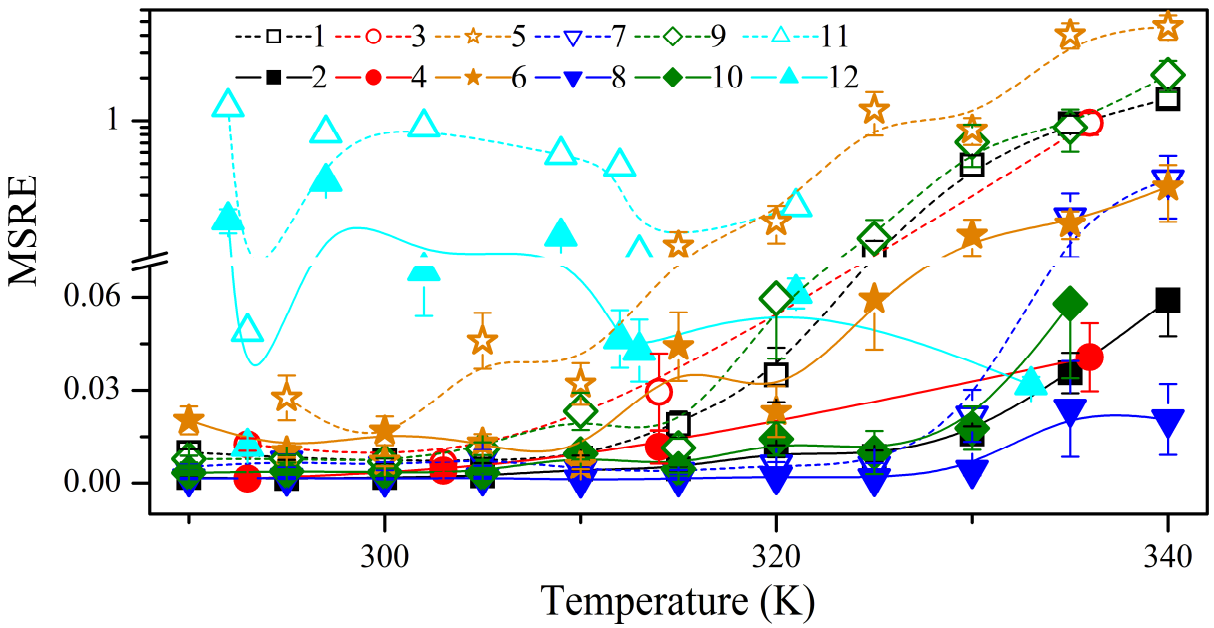

FIGURE 8S. Dependence of the MSRE on the temperature. Dataset: training (1, 2), T-varied (3, 4), B-varied (5, 6), Fe-varied (7, 8), d-varied (9,10), All-varied (11, 12). Deep neural network: DNN_{FeFeB} (1, 3, 5, 7, 9, 11), $DNN_{FeFeB\text{-}Fe}$ (2, 4, 6, 8, 10, 12).

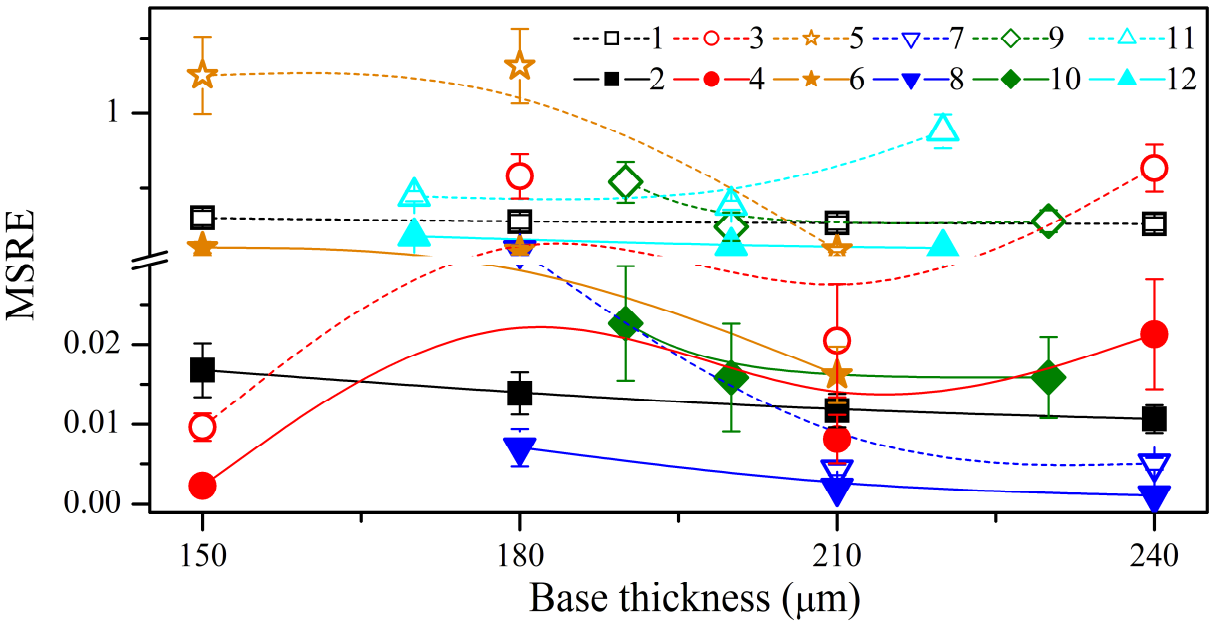

FIGURE 9S. Dependence of the MSRE on the base thickness. Dataset: training (1, 2), T-varied (3, 4), B-varied (5, 6), Fe-varied (7, 8), d-varied (9,10), All-varied (11, 12). Deep neural network: DNN_{FeFeB} (1, 3, 5, 7, 9, 11), $DNN_{FeFeB\text{-}Fe}$ (2, 4, 6, 8, 10, 12).

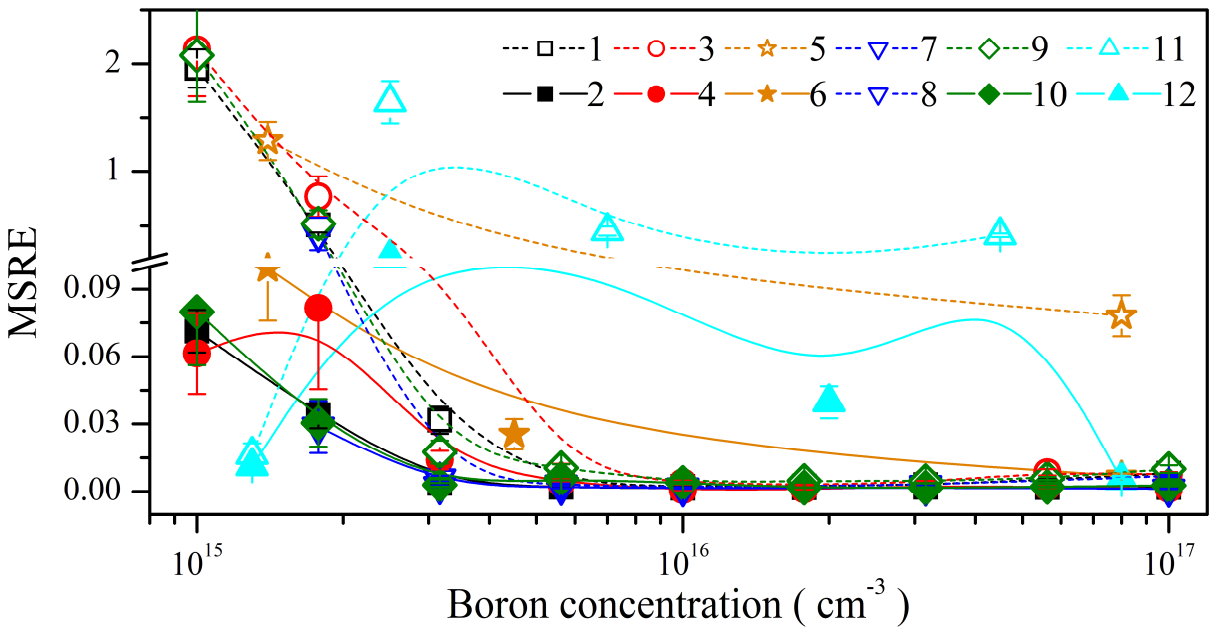

FIGURE 10S. Dependence of the MSRE on the boron concentration. Dataset: training (1, 2), T-varied (3, 4), B-varied (5, 6), Fe-varied (7, 8), d-varied (9,10), All-varied (11, 12). Deep neural network: DNN_{FeFeB} (1, 3, 5, 7, 9, 11), $DNN_{FeFeB\text{-}Fe}$ (2, 4, 6, 8, 10, 12).

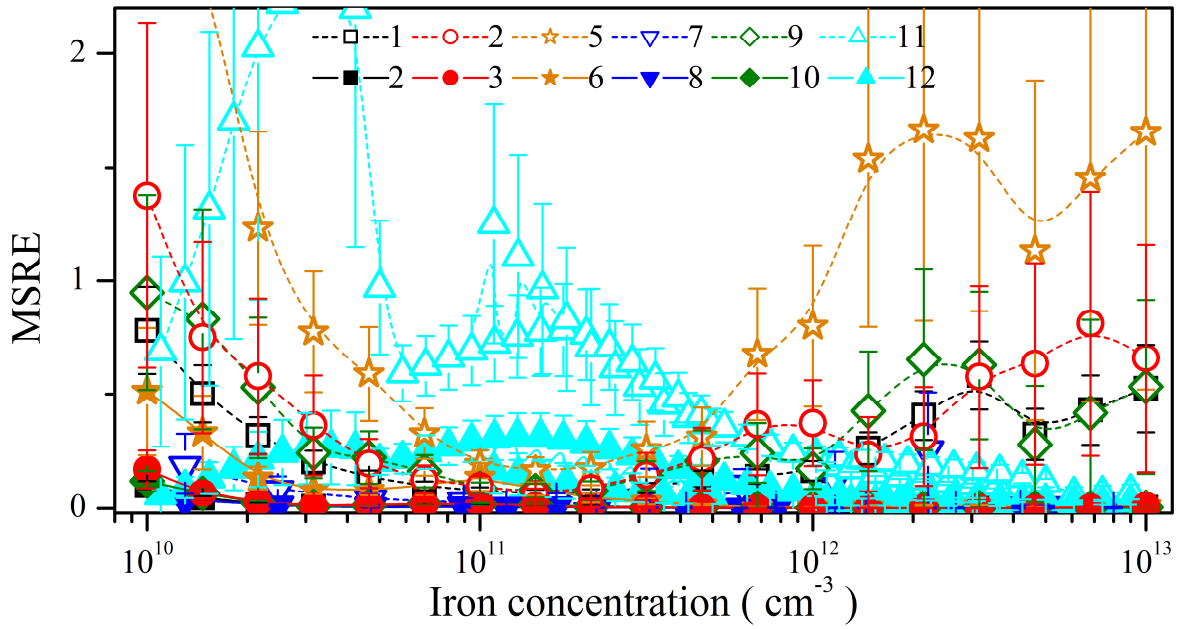

FIGURE 11S. Dependence of the MSRE on the iron concentration. Dataset: training (1, 2), T-varied (3, 4), B-varied (5, 6), Fe-varied (7, 8), d-varied (9,10), All-varied (11, 12). Deep neural network: DNN_{FeFeB} (1, 3, 5, 7, 9, 11), $DNN_{FeFeB\text{-}Fe}$ (2, 4, 6, 8, 10, 12).