Supporting Information

Improvement of bonding strength between ZnO nanorods and carbon fibers using magnetron sputtering ZnO films as interphase

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RF magnetron sputtering deposition is a plane coating technique, thus ZnO films and NRs could only cover one side of carbon fibers. The IFSS values presented in Fig. 2 were obtained when the carbon fibers were half coated by ZnO films and ZnO NRs. Subsequently we coated the both sides of carbon fibers with ZnO films and ZnO NRs under the conditions of 1, 5 and 9 presented in Table 1, and there is the highest improvement by 35.5% of IFSS value comparing with untreated carbon fiber. The value is also higher than the IFSS of carbon fibers with ZnO NRs grown directly.

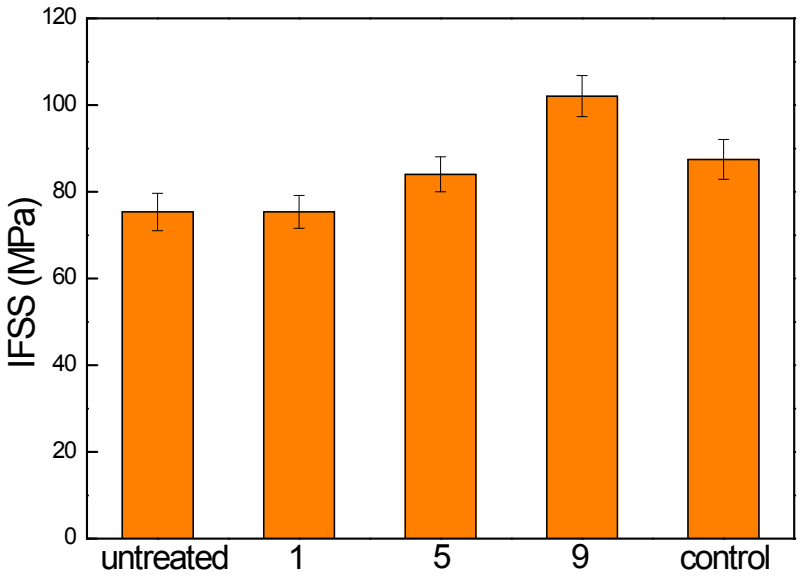

Fig. S1 IFSS values of untreated carbon fiber and carbon fibers coated with ZnO films and ZnO NRs on both sides under the RF magnetron sputtering conditions of 1, 5 and 9 in Table 1, respectively. Control group is the IFSS value of carbon fibers covered with ZnO NRs grown directly.

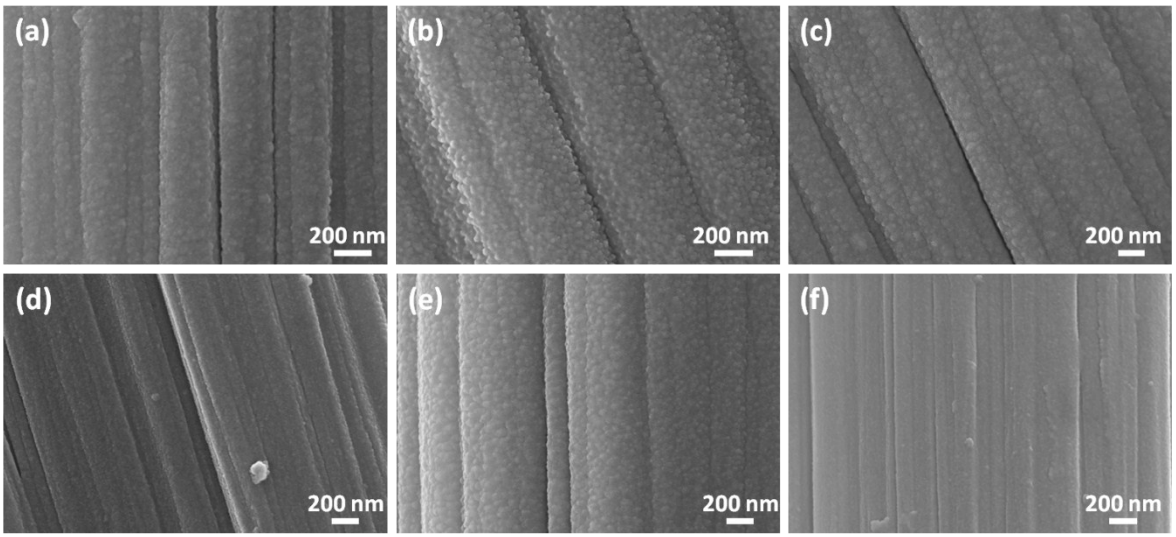

Fig. S2 Morphologies of ZnO films on carbon fibers under different RF magnetron sputtering conditions, (a), (b), (c), (d) and (e) correspond to magnetron sputtering conditions of 1, 3, 4, 5 and 7 in Table 1, respectively. And (f) is the morphology of carbon fiber surface covered with ZnO seeds directly.

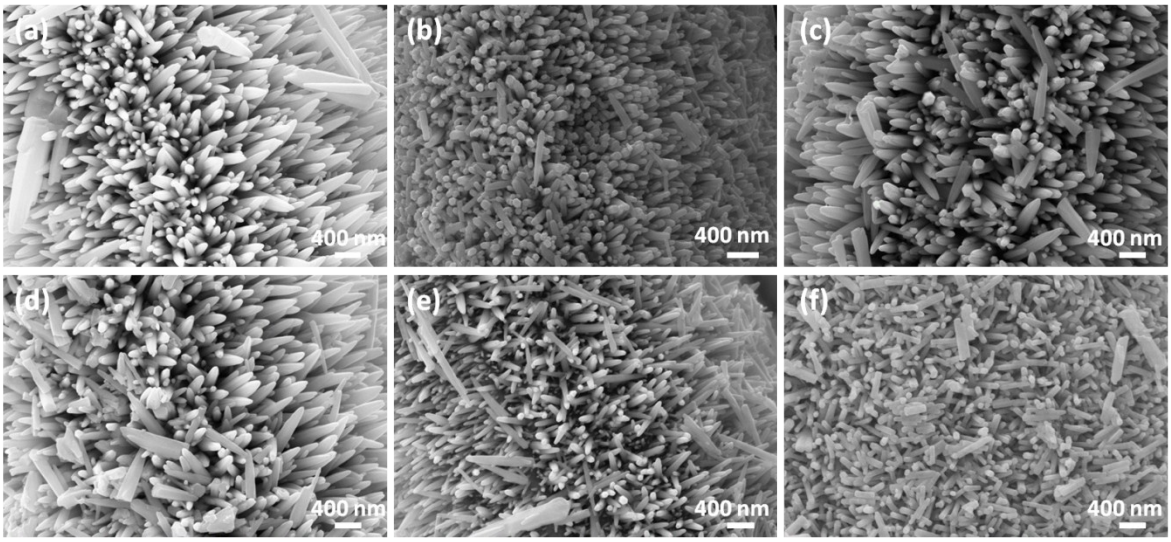

Fig. S3 Morphologies of ZnO NRs grew on ZnO films under different RF magnetron sputtering conditions. (a), (b), (c), (d) and (e) correspond to ZnO NRs grew following ZnO films of (a), (b), (c), (d) and (e) in Fig. S2, respectively. And (f) is the morphology of ZnO NRs directly grown on carbon fiber.

Table S1 Bonding states peaks locations and contents of the decomposed C 1s energy states of untreated carbon fibers and ZnO coated carbon fibers under condition of 9 in Table 1.

Samples	Content (%)			
	C=O (288.1eV)	C-O (286.5eV)	C=C (284.6eV)	C-O-Zn (283.7eV)
Untreated	--	19.4	80.6	--
ZnO Coated	4.1	--	62.5	33.4

Statistics analysis of the effects on IFSS of different factors at different levels:

K (MPa) for one factor is the average IFSS of three values of the certain level shown in Fig. 2. For the factor t (time), when deposition time was 20min, three values of IFSS were 46.80MPa, 56.81MPa and 62.93MPa in Fig. 2, respectively.

Thus K= (46.80+56.81+62.92)/3=55.51MPa, in 20min

Correspondingly, K= (62.09+50.82+63.16)/3=58.69MPa, in 40min

K= (58.58+68.94+77.15)/3=68.23MPa, in 60min

For T (°C) K values are calculated below:

K= (46.80+62.09+58.58)/3=55.83MPa, in RT

K= (56.81+50.82+68.94)/3=58.86MPa, in 100°C

K= (62.92+63.16+77.15)/3=67.75MPa, in 200°C

For O_2 pressure:

K= (46.80+63.16+68.94)/3=59.64MPa, in no O_2

K= (56.81+62.09+77.15)/3=65.35MPa, in O_2 pressure is 0.15

K= (62.92+50.82+58.58)/3=57.45MPa, in O_2 pressure is 0.30

For Power (W):

K= (46.80+50.82+77.15)/3=58.26MPa, in 100W

K= (56.81+63.16+58.58)/3=59.52MPa, in 150W

K= (62.92+62.09+68.94)/3=64.66MPa, in 200W

R is the difference between the maximal and minimal K values:

For t (time), R=68.23-55.51=12.72MPa

For T (°C), R=67.75-55.83=11.92MPa

For O_2 pressure, R=65.35-57.45=7.91MPa

For Power (W), R=64.66-58.26=6.40MPa