

Supporting Information

E-seed skin: Carbohydrate-protein hybrid nanostructure for delayed germination and accelerated growth

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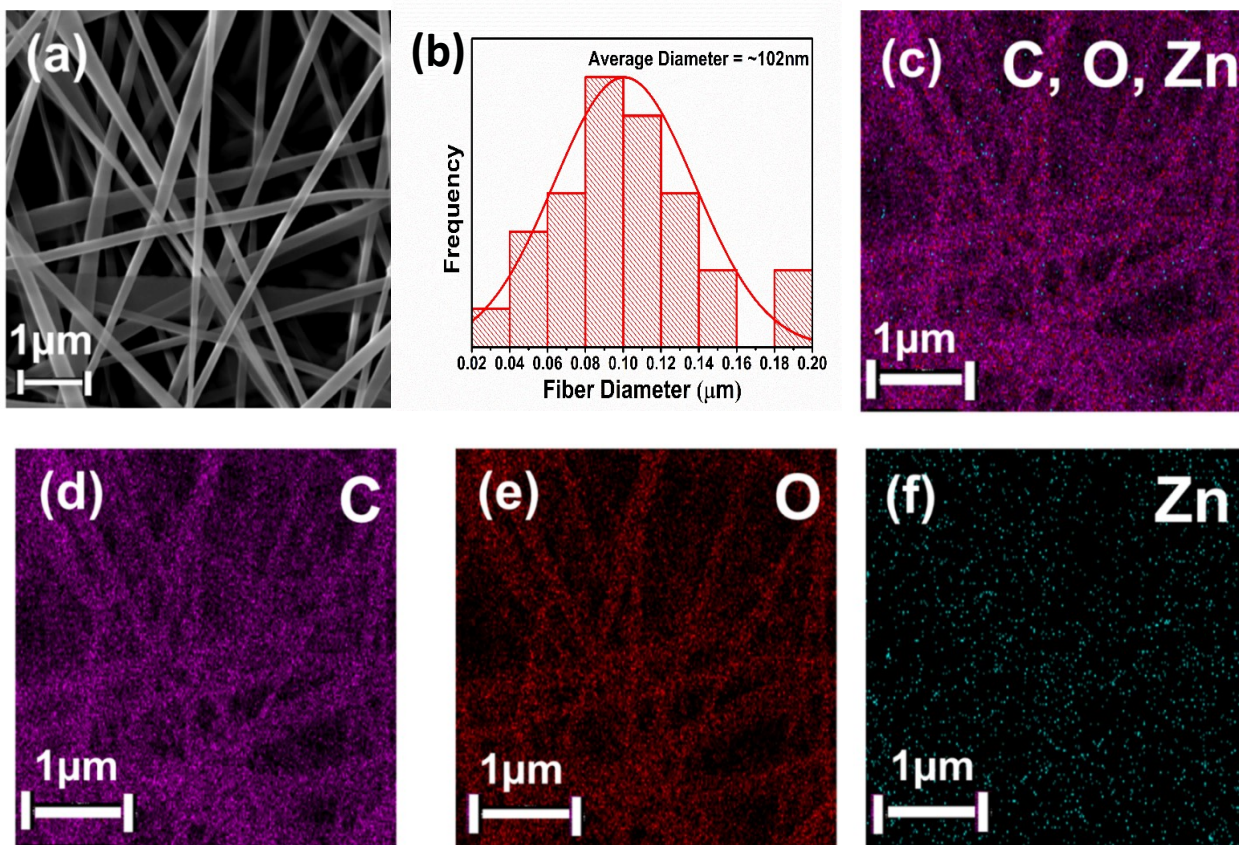


Figure S1. (a) SEM image of the morphology of PVA/Pec/Zn nanofibers; (b) Average fiber diameter distribution graph of PVA/Pec/Zn-NF for $n=50$ and (c-f) corresponding EDAX mapping showing elemental composition.

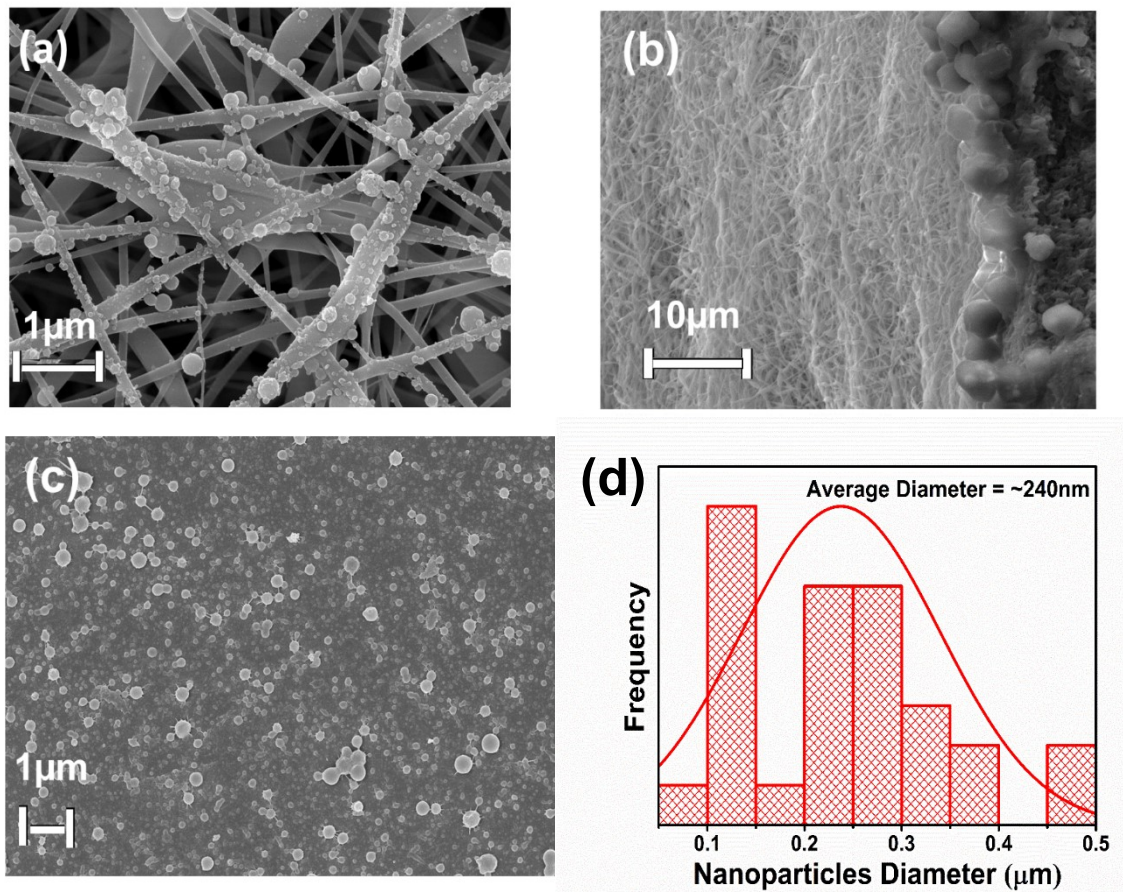


Figure S2. SEM images of (a) collagen electrospun for 30 minutes over PVA/Pec/Zn-NF; (b) cross-section of 6 hours collagen electrospun over PVA/Pec/Zn-NF (c) SEM image of electrospun collagen nanoparticles and (d) Average nanoparticles diameter distribution graph for n=50.

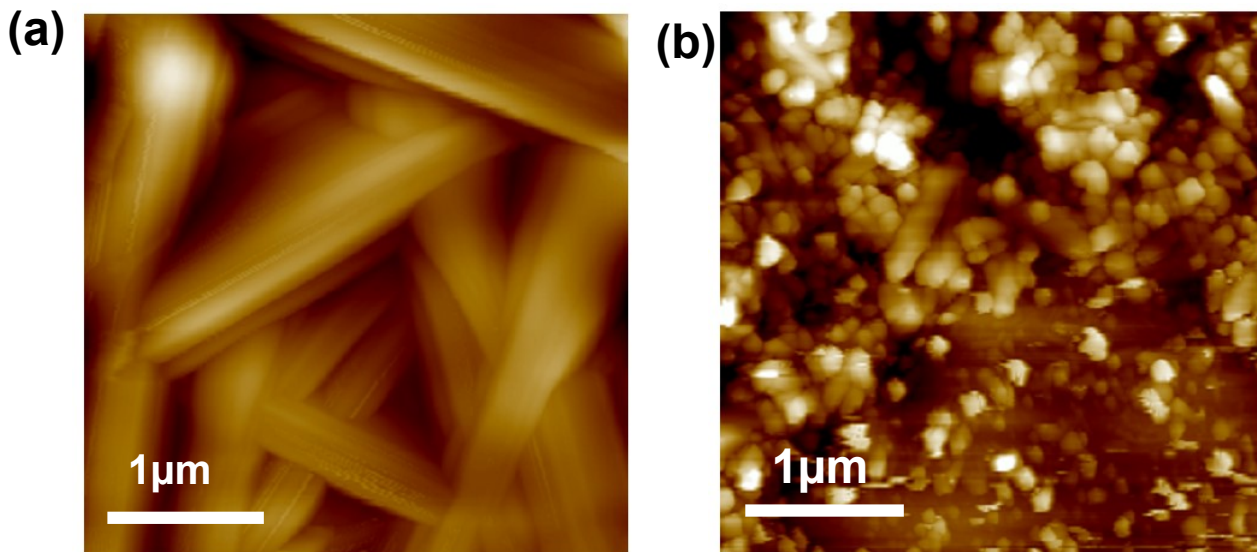


Figure S3. AFM image of (a) PVA/Pec/Zn-NF and (b) PVA/Pec/Zn/Col-NF after 6 h of electrospaying.

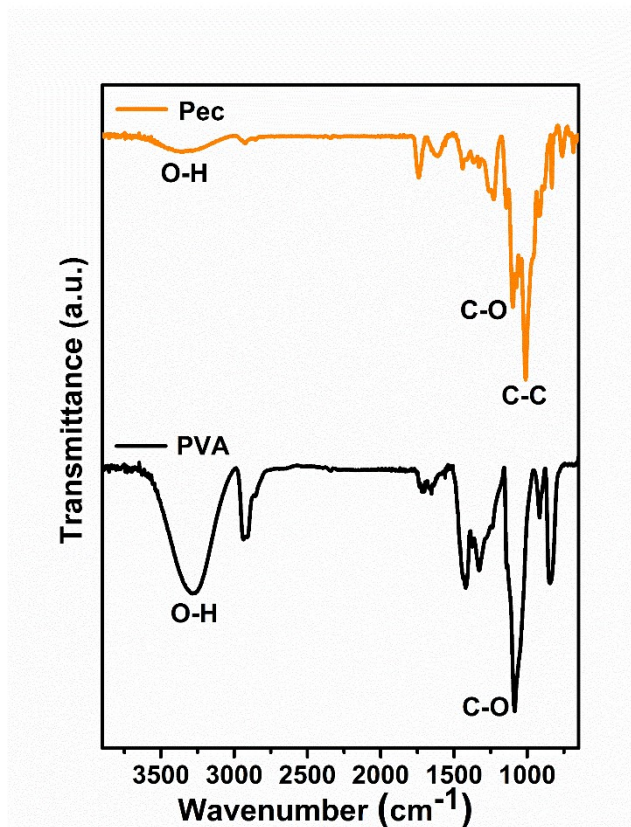


Figure S4. FTIR spectra of PVA and pectin.

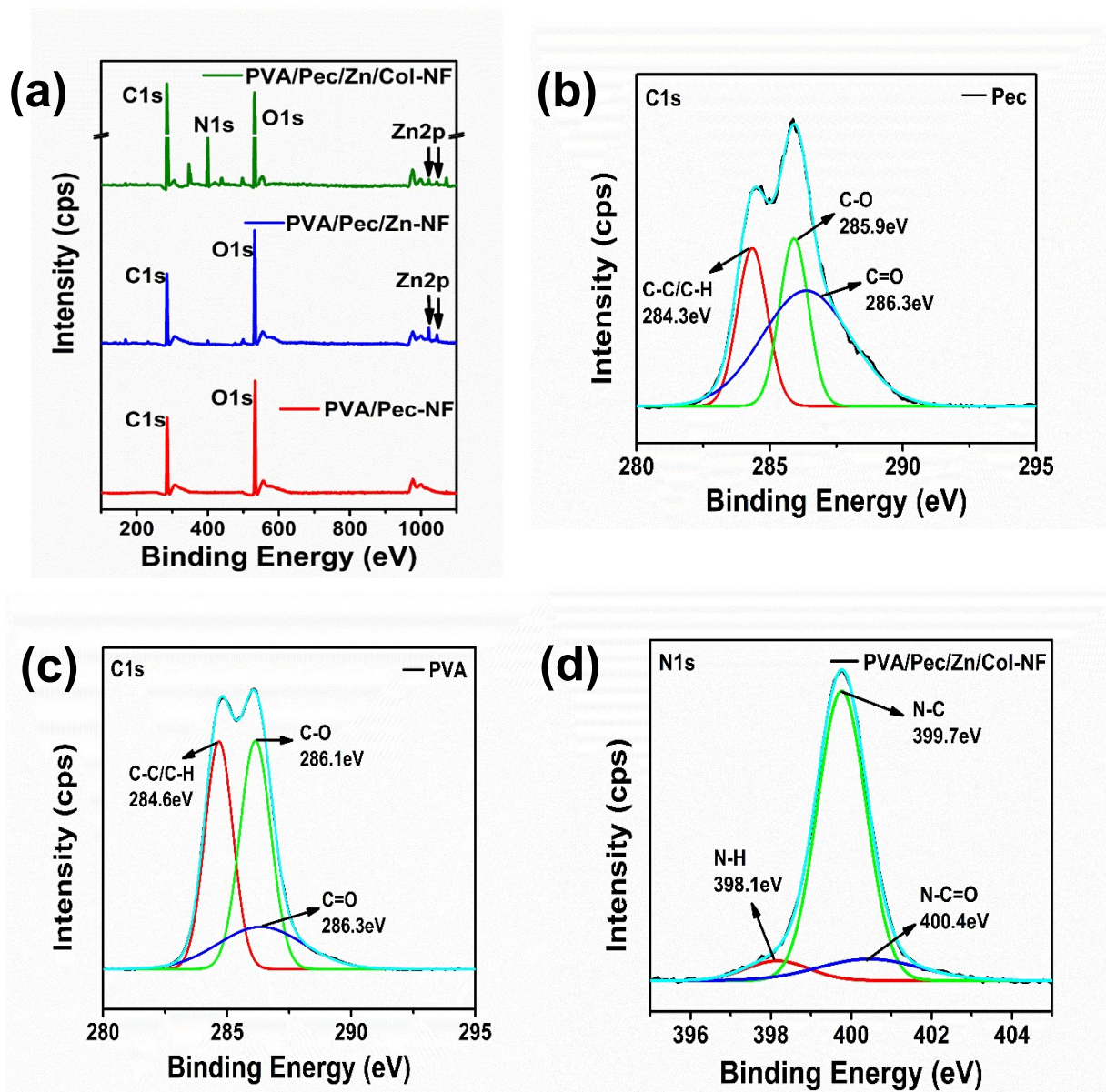


Figure S5. (a) XPS survey spectra of PVA/Pec/Zn/Col-NF, PVA/Pec/Zn-NF, and PVA/Pec-NF, (b) C1s XPS spectrum of pectin, (c) C1s XPS spectrum of PVA, and (d) N1s XPS spectrum of PVA/Pec/Zn/Col-NF.

Table S1. Percentage of crystallinity index of PVA-NF, PVA/Pec-NF, PVA/Pec/Zn-NF, and PVA/Pec/Zn/Col-NF.

Nanofiber Samples	Crystallinity Index (%)
PVA-NF	45
PVA/Pec-NF	39
PVA/Pec/Zn-NF	36
PVA/Pec/Zn/Col-NF	30

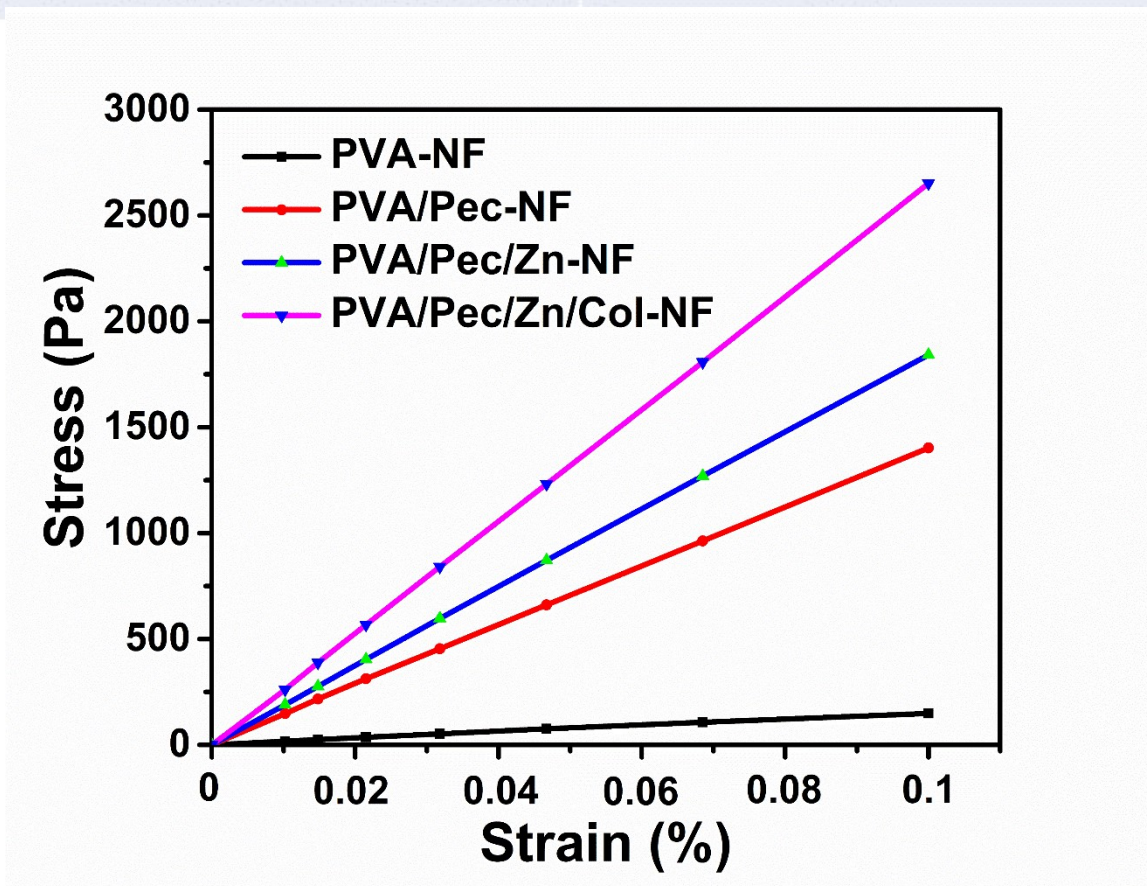


Figure S6. Stress-strain curves of PVA-NF, PVA/Pec-NF, PVA/Pec/Zn-NF, and PVA/Pec/Zn/Col-NF.

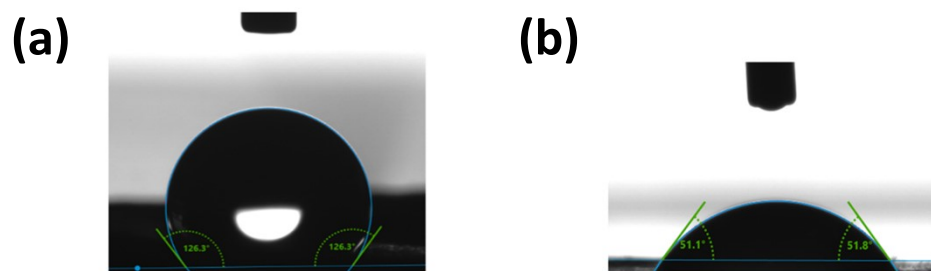


Figure S7. Images showing static water contact angles of (a) PVA/Pec/Zn/CoI-NF, and (b) PVA/Pec/Zn-NF.

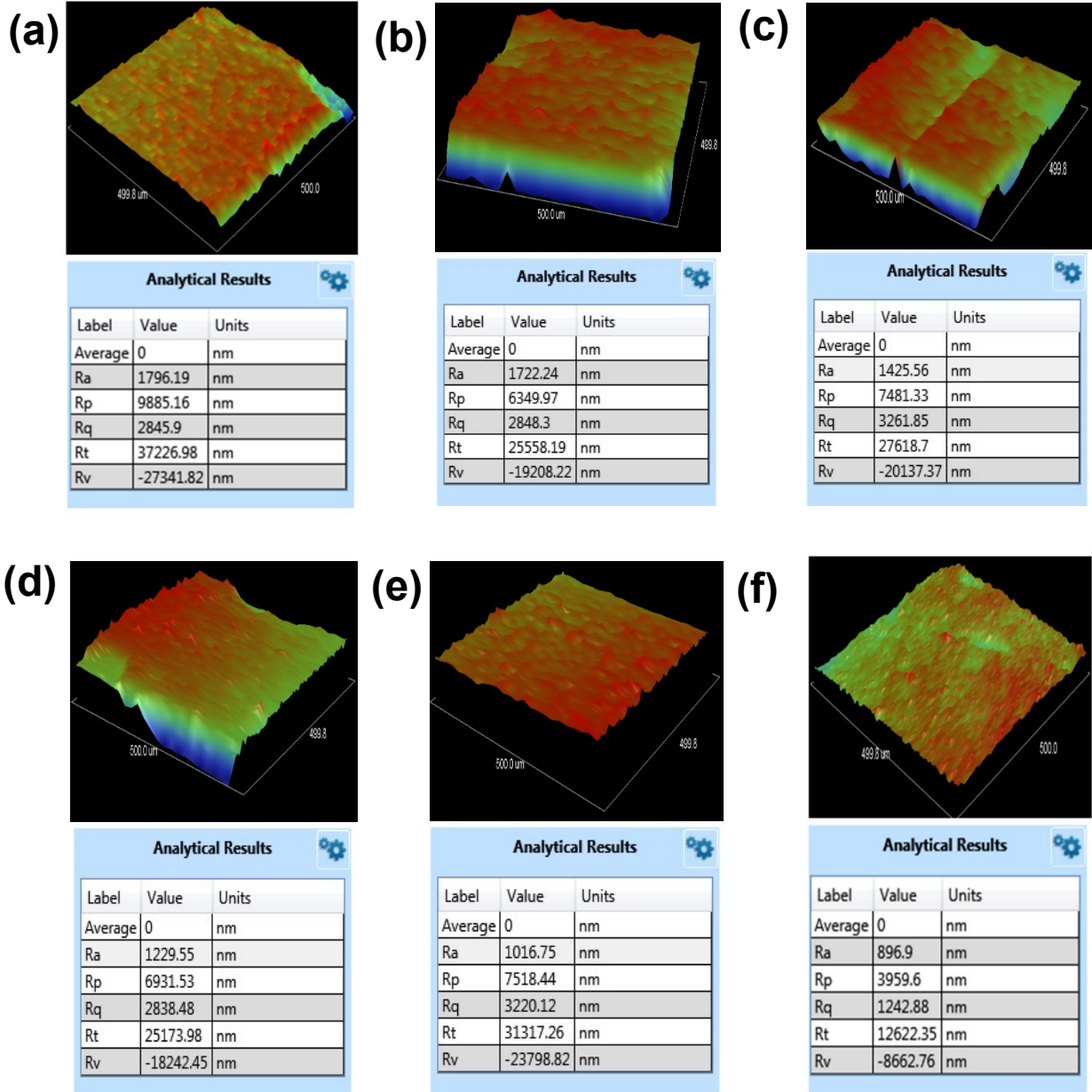


Figure S8. Surface roughness images of PVA/Pec/Zn-NF (a) before and (b-f) after collagen electrospinning of 0.5, 1, 1.5, 3, 6h, respectively captured using surface profilometer.

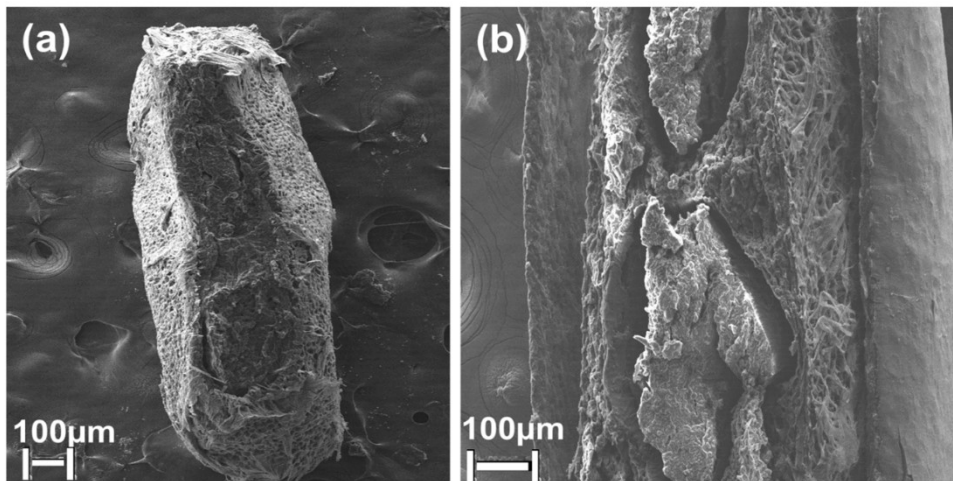
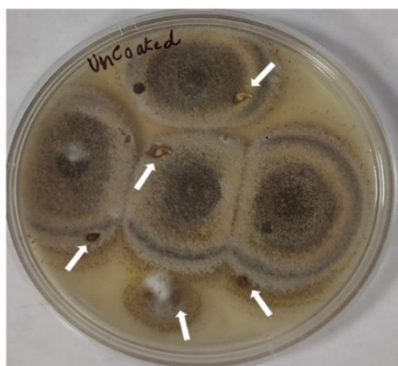
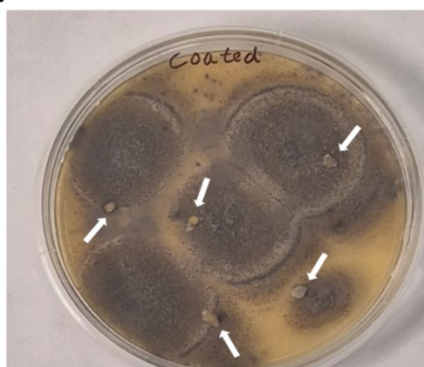


Figure S9. SEM image of the cross-sectional morphology of (a) uncoated and (b) PVA/Pec/Zn/Col-NF coated seed.

(a) Uncoated



(b) PVA/Pec-NF



(c) PVA/Pec/Zn-NF



(d) PVA/Pec/Zn/Col-NF



Figure S10. Images showing *Colletotrichum* fungal mat on potato dextrose agar plates along with (a) uncoated, (b) PVA/Pec-NF, (c) PVA/Pec/Zn-NF (control experiments), and (d) PVA/Pec/Zn/Col-NF (treatment) coated seeds for assessing seed germination efficiency under biotic stress. White arrows represent the position of seeds.