



Visible light active photocatalytic cellulose acetate/Co-ZnO nanofiber membranes for active food packaging

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Introduction and objectives

As a solution for hunger and food insecurity, to improve the shelf life of fruits, a food packaging material of electrospun nanofiber membrane embedded with visible light active Co doped ZnO (Co-ZnO) nanoparticles (NPs) is developed in this work.

It is used to extend the shelf life of strawberries, using the photocatalytic mechanism of Co-ZnO since it generates radicals under visible light and can degrade the microbes in fruits and also slow down excess metabolic activities caused by compounds such as ethylene.

Since ZnO is mainly activated under high energy UV range, it is doped with Co to bring it to visible range which is the majority of sun light.

Methodology

Synthesis of Co-ZnO NPs

Photocatalytic experiment to determine best photocatalyst



Co-ZnO NPs



6 mL CA solution of DMF: acetone in 1:2 v/v



Electrospinning process

Preparation of Cellulose acetate and Co-ZnO solution



Application



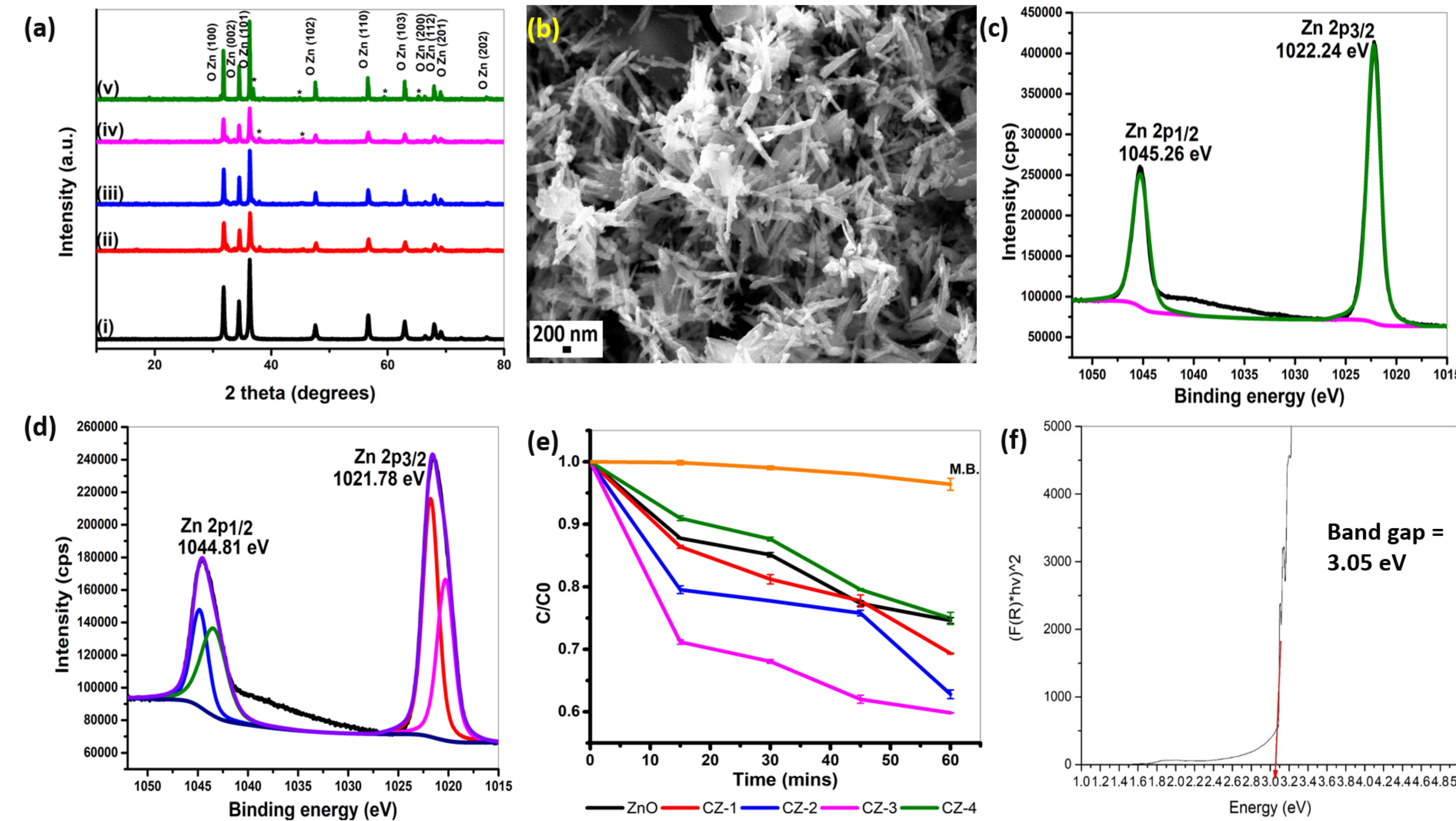
Developed NF

Application of active packaging for strawberries

Electrospinning process to develop nanofiber (NF)

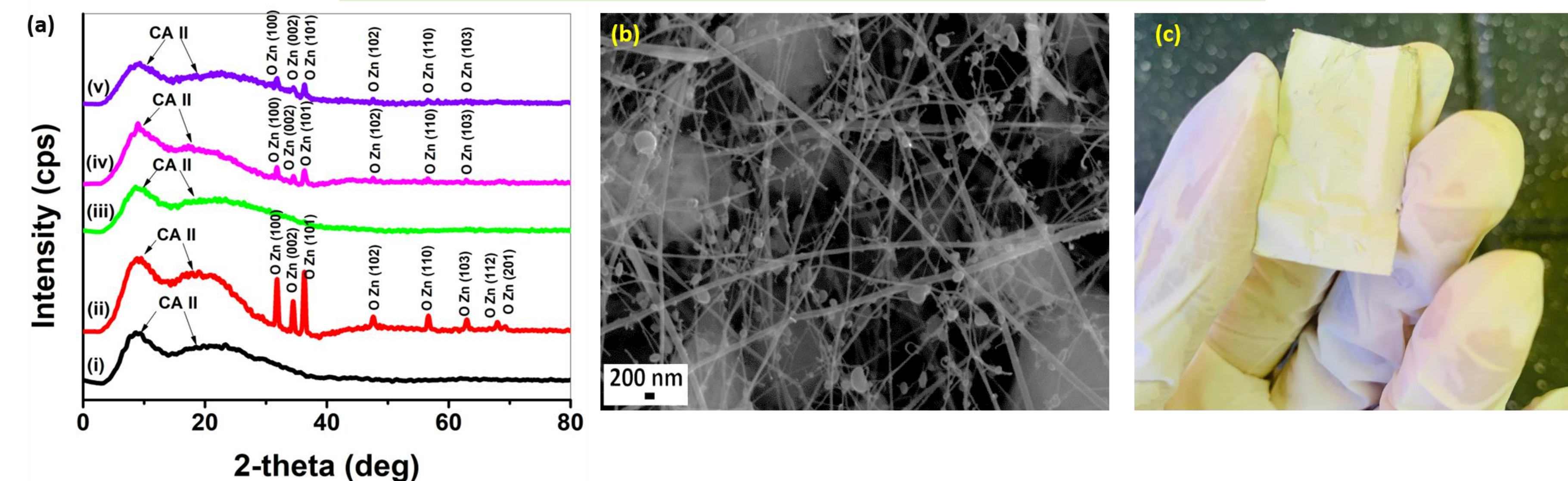
Results and discussions

Characterization of synthesized Co-ZnO NPs



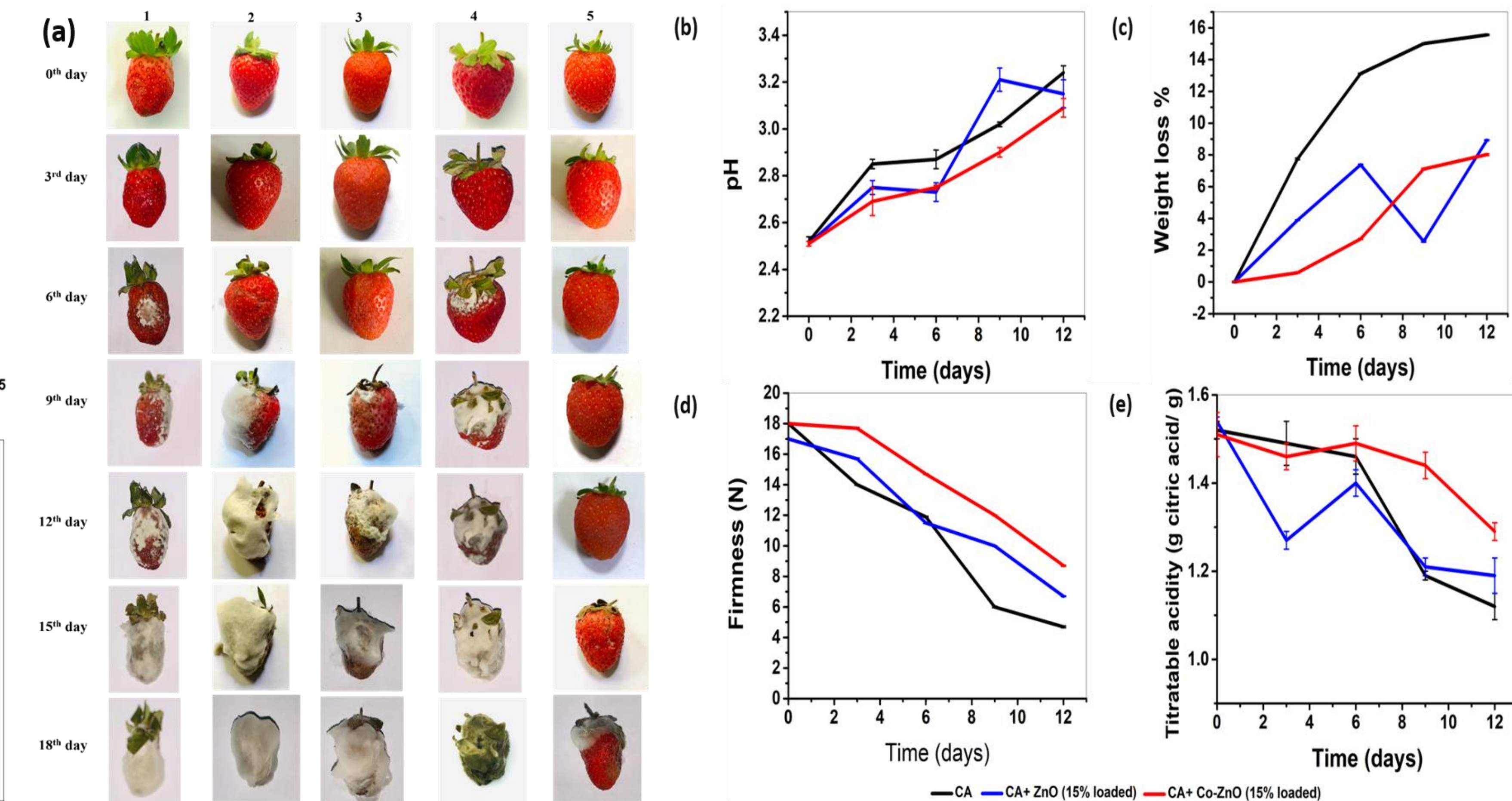
(a) PXRD patterns of (i) ZnO, (ii) Co-Z 1, (iii) Co-Z 2, (iv) Co-Z 3 and (v) Co-Z 4, (b) Scanning electron microscope (SEM) image of Co-Z 3, Zn 2p core-level spectrum of (c) undoped ZnO, (d) Co-Z 4, (e) photocatalytic degradation of samples under sunlight and (f) Tauc's plot of Co-Z 3

Characterization of developed electrospun NF mats



(a) PXRD patterns of electrospun (A) pure CA, (B) CA with ZnO, (C) CA with Co-Z 3 (5% loaded), (D) CA with Co-Z 3 (10% loaded) and (E) CA with Co-Z 3 (15% loaded) mat, (b) SEM image of CA with Co-Z 3 (15% loaded) mat and (c) photograph of developed electrospun CA with Co-z 3 (15% loaded) mat

Application of developed NF mats and physicochemical parameters analysis



(a) Shelf life studies of strawberries, using electrospun NF mats (1) without any mat, with (2) pure CA, (3) CA+ ZnO (15% loaded and (4) CA+ Co-Z 3 (15% loaded) without VL and (5) CA+ Co-Z 3 (15% loaded) with VL up to 18 days, analysis of (b) pH, (c) % weight loss, (c) firmness and (d) titratable acidity of strawberries placed in PET boxes with nanofiber mats.

Conclusions

- successful synthesis of ZnO and Co-ZnO NPs
- Successful incorporation of Co into ZnO
- Best photocatalyst was Co-Z 3
- Successful loading of catalyst into CA mat
- Shelf life increment of best mat up to 18 days

References

- Adeel, M.; Saeed, M.; Khan, I.; Muneer, M.; Akram, N., (2021) *ACS Omega*, **1426–1435**.
- Pragna, E.; Ramanadha, M.; Sudharani, A.; Kumar, K. S., (2021) *J Supercond Nov Magn*, **1507–1516**.