Manufacturing Stable and Functional Hydrogel Nanofibers from Metal Ion Containing Polymer Blends (CMMI-1462859)

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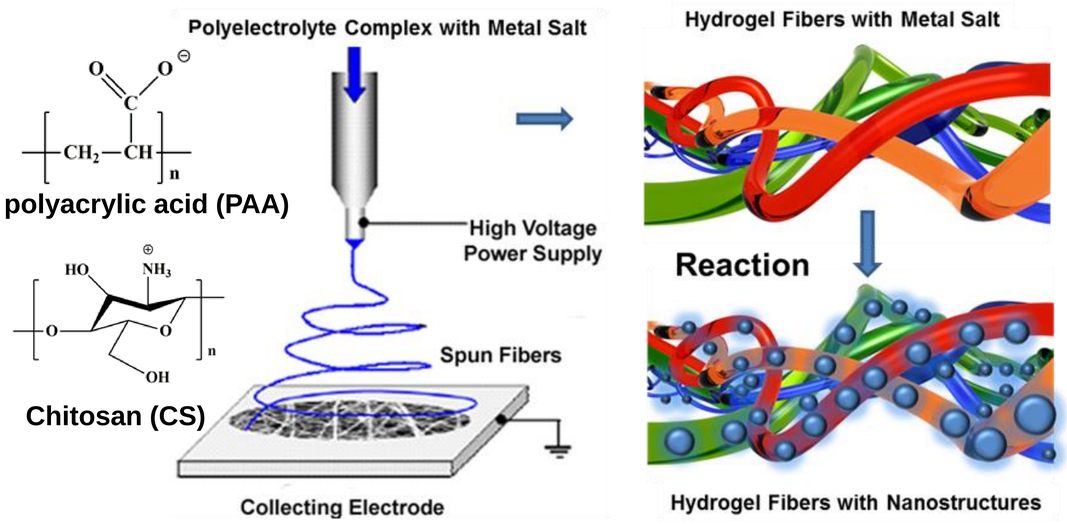
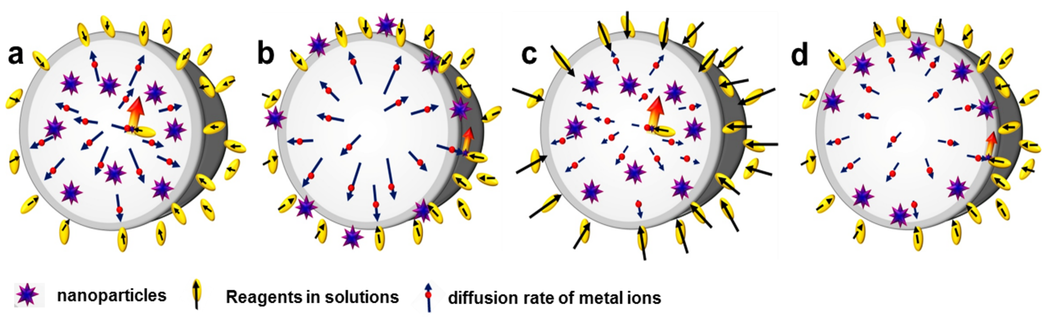


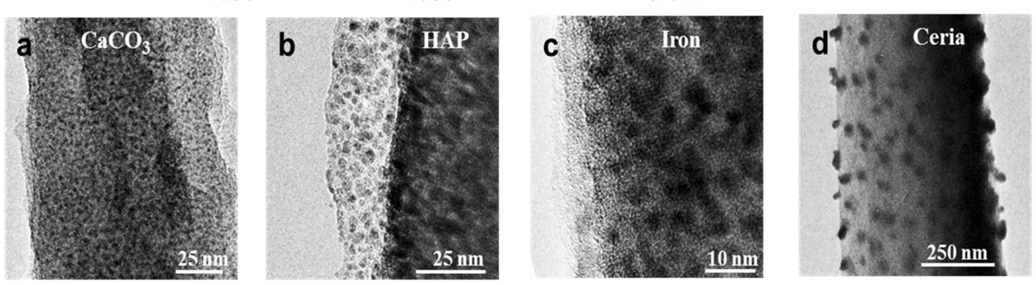
Hypothesis: The location of nanoparticles on fibers is determined by metal ion diffusion rate and reaction rate.



Diffusion of Metal Ions	Weak metal ion/electrolyte interactions (Fast diffusion)	Strong metal ion/electrolyte interactions (Slow diffusion)
Fast Reaction	Formation of calcium carbonate **Position: Inside fibers (a)**	Formation of iron nanoparticles **Position: Inside fibers (c)**
Slow Reaction	Formation of hydroxyapatite **Position: On fiber surface (b)**	Formation of ceria nanoparticles **Position: Close to fiber surface (d)**

Reaction: $Ca^{2+} + CO_3^{2-}$ fast Biomineralization slow $Fe^{3+} + NaBH_4$ fast $Ce^{3+} + NH_4OH$ slow

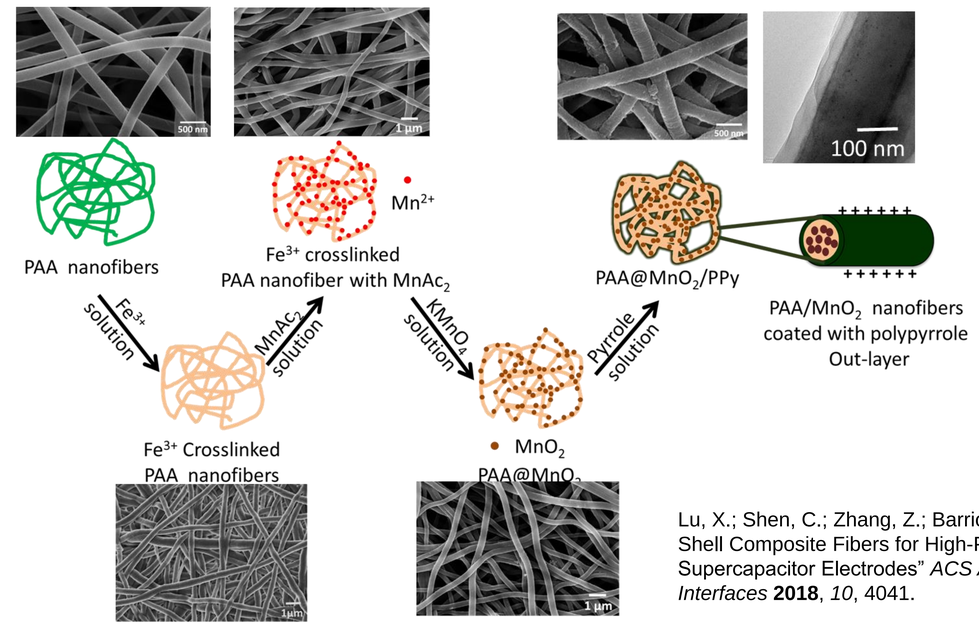
Diffusion: Fast Fast Slow Slow



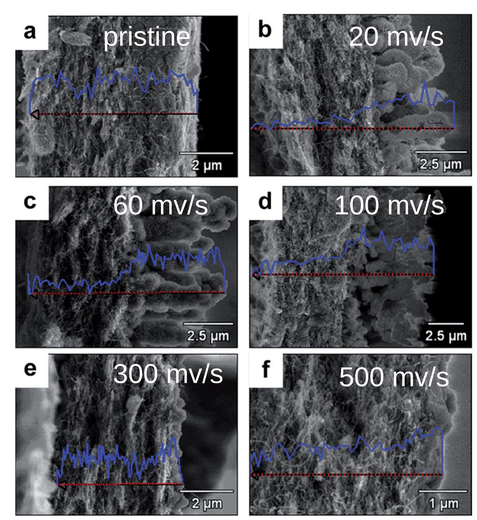
Transmission electron microscopy (TEM) images of nanoparticles produced from different metal ions in hydrogel fibers through different reactions. a) Calcium carbonate nanoparticles, b) hydroxyapatite, c) iron and d) ceria nanoparticles.

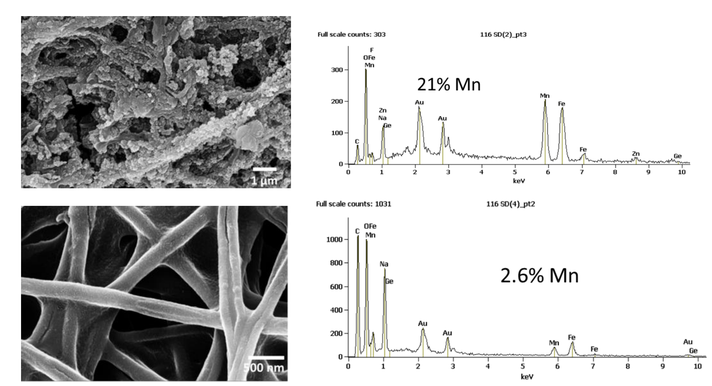
Malhotra, A.; Bera, T.; Zhai, L. "Bioinspired Metal Ion Coordinated Polyelectrolyte Fibrous Nanoreactors" *Adv. Mater. Interfaces* **2016**, *3*, 160092.

Metal ion Loaded Polyelectrolyte Fibers as Supercapacitor Electrodes



Lu, X.; Shen, C.; Zhang, Z.; Barrios, E.; Zhai, L. "Core-Shell Composite Fibers for High-Performance Flexible Supercapacitor Electrodes" *ACS Appl. Mater. Interfaces* **2018**, *10*, 4041.





Scan rate (mV/s)	10	20	50	100
PAA@MnO_2 (F/g)	288	262	229	214
PAA@MnO_2 /PPy (F/g)	564	543	461	403

NSTC i Nano Activities on UCF STEM Day

Acknowledgements:
Dr. Chen Shen
Dr. Jean Calderon
Dr. Tanmay Bera
Elizabeth Barrios
Materials Characterization Facility at the University of Central Florida