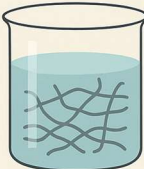


Submission Date: 05/09/2025

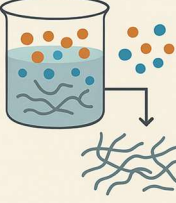
2024 Academic Year Bio-SPMs Collaborative Research
Research Report Summary

Title of the research project		Unraveling protein interactions by novel nano-scale interpretations (ProNano)	
PI (Person in charge of the research project)	Name	Antonio Capezza (Ph.D.)	
	Affiliated Institution and Department/Division/etc.	KTH Royal Institute of Technology	
	Position	Researcher	
Bio-SPMs that you used (Check the boxes)		<input type="checkbox"/>	Atomic resolution/3D-AFM
		<input checked="" type="checkbox"/>	High-speed AFM
		<input type="checkbox"/>	SICM
		<input type="checkbox"/>	AFM for Cell Measurement
Collaborative NanoLSI Faculty Members		Assist. Prof. Neval Yilmaz	
<p>This project investigates the nanoscopic properties of a novel biodegradable absorbent based on whey protein nanofibrils (PNFs). While macroscopic observations have established that PNF hydrogel formation is closely associated with ionic charge and nanoscale interactions between nanofibrils and ions, the underlying nanoscale details of PNF formation and organization, both in the presence and absence of metal ions, have remained to be fully elucidated.</p> <p>In this collaborative study, we examined the effect of metal ions, such as NaCl, CoCl₂, and AlCl₃, on PNF structure, and monitored the dynamics of both the fibrillation and defibrillation processes. Our main findings are summarized as follows:</p> <p>1. Impact of Metal Ions on PNF Dimensions: NaCl produces thinner fibrils, whereas CoCl₂ results in shorter fibrils. In contrast, AlCl₃ does not induce significant morphological changes.</p> <p>2. Defibrillation at High Ionic Strength: Elevated ionic strength destabilizes PNFs, leading to their defibrillation. The real-time observations of this process have provided valuable insights into how metal ions modulate PNF structure.</p> <p>3. Fibrillation Dynamics: We have discovered that small PNF seeds facilitate fibrillation under conditions of moderate ionic strength. Fibrillation occurs through a process of simultaneous growth and twisting, producing structures resembling twisted ribbons or helical ribbons.</p> <p>Collectively, these findings enhance our understanding of PNF behavior and will help in tailoring protein-based material properties.</p>			




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Defibrillation at High Ionic Strength





Impact of Metal Ions on PNF Dimensions



Na⁺ Cl⁻


Thinner fibrils






Co³⁺ Cl⁻


Shorter fibrils



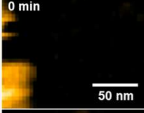


AlCl₃


No significant change



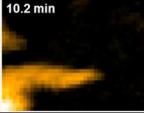
Fibrillation Dynamics




0 min



6.0 min



10.2 min



13.3 min

50 nm