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# Collagen-bound high molecular polyelectrolyte ameliorates intrafibrillar mineralisation

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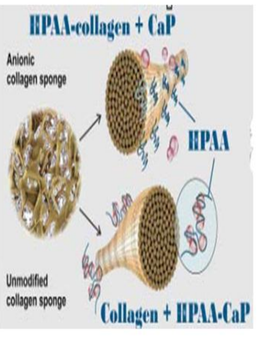
## 1. Introduction

In the past, incorporation of non-collagenous proteins(NCP) or analogs into the mineralization medium has been considered as an indispensable process. However, it is inevitable that there are defects such as difficulty in application and biological toxicity in these techniques. Thus, how to utilize the NCP analogue to induce the intrafibrillar mineralization simultaneously to avoid the toxicity of these analogs have to be settled urgently.

## 2. Hypothesis

It is possible to induce intrafibrillar mineralization with a high molecular weight polyelectrolyte bound collagen model without any NCP analogs in the mineralization medium.




## 3. Results & Discussion

High molecular weight polyacrylic acid(PAA, Mw. 450KDa) was crosslinked to collagen molecules via covalent bond. The PAA bound collagen model was incubated in calcium phosphate solution without any nucleation inhibitors. More effectively intrafibrillar mineralisation with better biomechanical properties was achieved compared with mineralisation of unmodified collagen in nucleation inhibitor-stabilised calcium phosphate solution

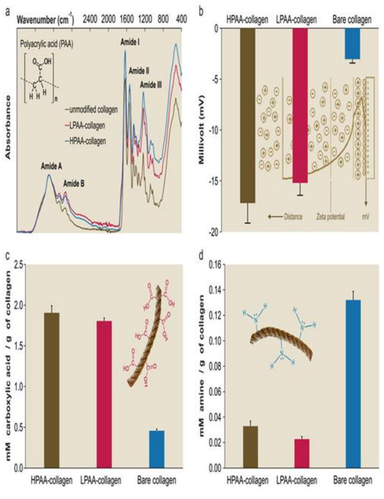



Fig.1. characterization of HPAA bound anionic collagen model

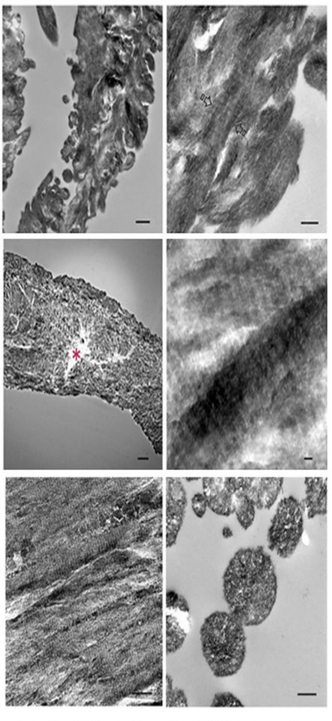


Fig.2. TEM of mineralized HPAA bound collagen sponge or rat tail collagen

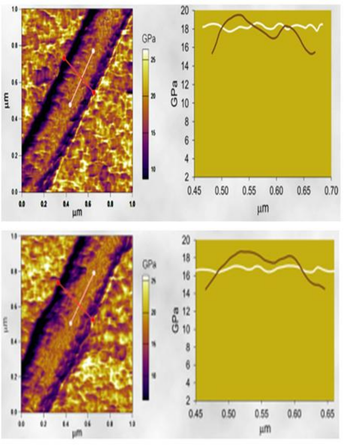



Fig.3. Young's modulus of mineralized HPAA bound collagen (AFM)

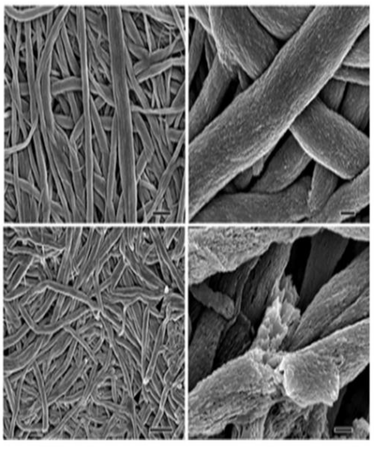


Fig.4. SEM of mineralized HPAA bound collagen sponge

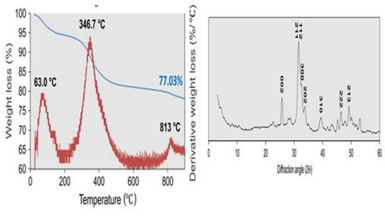



Fig.6. TGA and XRD characterization of mineralized HPAA bound collagen

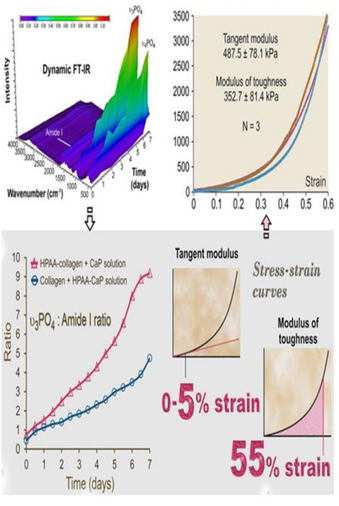



Fig.5. Dynamic FTIR and Stress-strain of mineralized HPAA bound collagen

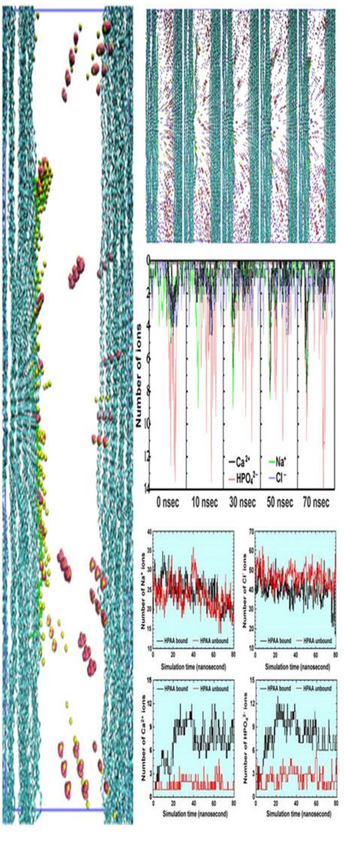



Fig.7. Molecule dynamic simulation of HPAA bound collagen mineralized in CaP

## 4. Conclusion

Here, we develop a biomineralization scheme that results in intrafibrillar mineralization of collagen with high molecular weight polyacrylic acid bound to collagen directly. The mineralization mechanism involves precipitation and crystal growth of polymer-induced prenucleation clusters within the intrafibrillar spaces of hierarchically-mineralized collagen.

## 5. Significance

High molecular weight polyelectrolyte bound collagen model bridges the gaps exist with respect to how intrafibrillar mineralisation is affected by the presence of collagen-bound nucleation inhibitors, and validates the recently-proposed mineralisation mechanisms, Gibbs-Donnan equilibrium, are applicable to nucleation inhibitor-bound collagen.