

Orientation and number of blocks influence structure and self-assembly of protein copolymers

Jennifer S. Haghpanah¹, Carlo Yuvienco¹, Peter J. Baker¹, Hanna Barra¹, Deniz E. Civay², Sachin Khapli¹, Natalya Voloshchuk¹, Mukta Asnani¹, Susheel K. Gunasekar¹, Murugappan Muthukumar², and Jin Kim Montclare^{1,3}

Chemical & Biological Sciences, Polytechnic Institute of NYU, Brooklyn, NY, 11201¹

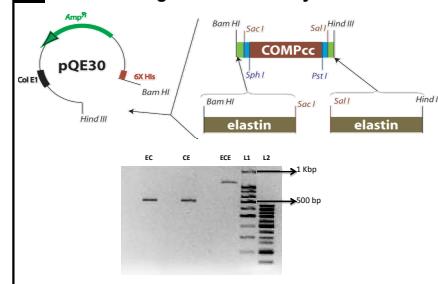
Polymer Science and Engineering Department, University of Massachusetts, Amherst, MA 01003²

Department of Biochemistry, SUNY Downstate Medical Center, Brooklyn, NY, 11203³

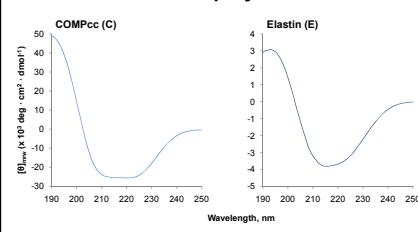
1 Abstract

The requirement for smart biomaterials to change in macromolecular structure in response to external stimuli necessitates the design of controllable modes of self-assembly. Driven by this need and inspired by the natural self-assembly of proteins, we describe the biosynthesis and characterization of three block polymers that consist of a b-spiral elastin-mimetic polypeptide (E) and the α -helical coiled-coil region of cartilage-oligomeric matrix protein (C). These proteins, synthesized as the block sequences – EC, CE, and ECE – were chosen for their distinct structures, functions, and modes of self-assembly. For these fusion constructs we demonstrate that the block orientation and the number of repeated blocks of the two protein motifs play a significant role in their self-assembly on the micro- and macroscale. Our results provide insight into the future development of smart biomaterials with emergent properties.

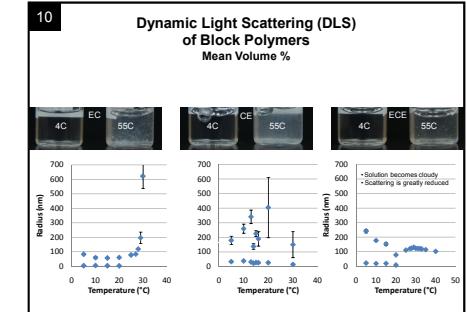
4 Cloning of Block Co-Polymers



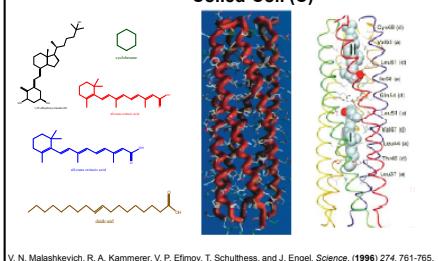
7 Circular Dichroism (CD) of Homopolymers



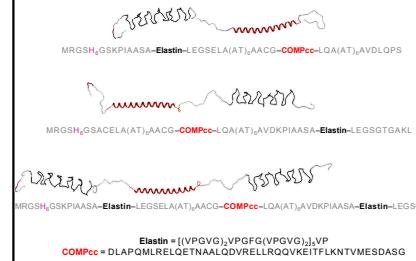
10 Dynamic Light Scattering (DLS) of Block Polymers



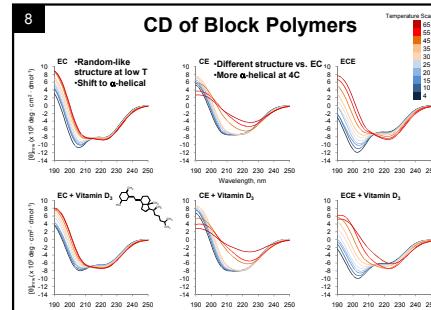
2 Cartilage Oligomeric Matrix Protein Coiled-Coil (C)



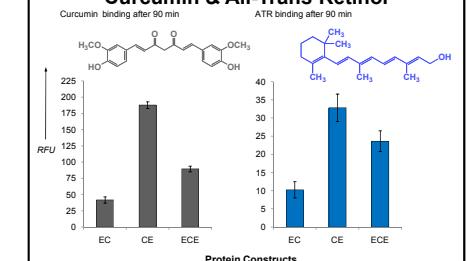
5 Protein Block Polymers



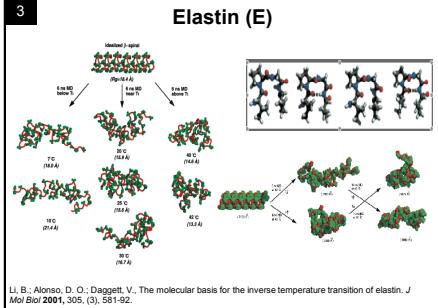
8 CD of Block Polymers



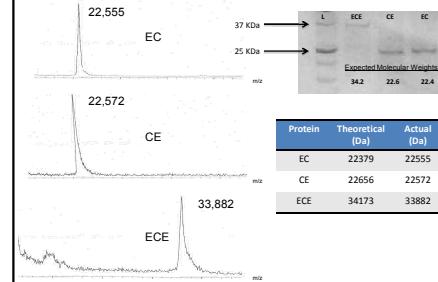
11 Binding of Polymers to Curcumin & All-Trans Retinol



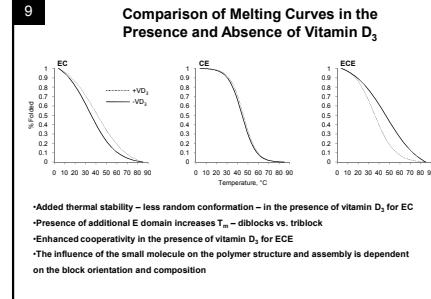
3 Elastin (E)



6 Protein Purification & MALDI Analysis



9 Comparison of Melting Curves in the Presence and Absence of Vitamin D₃



12 Conclusions & Future Work

- Our studies with CD and DLS suggest that the physicochemical behaviors of EC and CE constructs, compositionally similar macromolecules, are different.
- Further comparison with ECE shows that the number of blocks contributes to modes of self-assembly taking place.
- We will continue to study rheological properties of the constructs.
- We hope these block co-polymers will provide protein engineers with an extra level of control for drug delivery. These will also serve as novel scaffolds for tissue engineers.

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