

CURRICULUM VITAE

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Education

2003	Sc.D	Massachusetts Institute of Technology	Polymer Science and Engineering Minor in Mechanical Engineering
1995	M.S.	Seoul National University	Chemical Engineering
1993	B.S.	Seoul National University	Chemical Engineering

Research Experience

Jan 2007 – Present University of Maryland College Park, MD
Assistant Professor in Materials Science and Engineering
and Fischell Bioengineering

July 2003 – Jan 2007 Harvard Medical School Boston, MA
Advisor: Timothy A Springer

The postdoctoral training focuses on measuring mechanical properties of cell adhesion molecules at single molecule level using atomic force microscopy (AFM) and optical tweezer. The single molecule construct with titin I27 domain was prepared to provide a signature of a single molecule AFM experiment. I built custom-made AFM to mechanically unfold domain 1 and domain 2 of intercellular adhesion molecule-1 (ICAM-1). Surprisingly the mechanical resistance of two domains of ICAM-1 was as strong as muscle protein, titin I27, and interesting interdomain interaction between domain 1 and domain 2 of ICAM-1 was observed. The second project was probing mechanical properties of integrin I domain using optical tweezer. I domain is the binding domain of the integrin and its affinity to its ligand is regulated by allosteric mechanism. Unfolding and refolding of I domain were observed in repeated pulling cycles and average unfolding and refolding forces were 9.1 pN and 4.7 pN, respectively. Multiple intermediate states were observed in force-clamping experiment and contour lengths calculated between different states in force-clamping experiment were able to be correlated with hypothetical force bearing structure, suggesting that proteins secondary structure is already formed during force clamping experiment and multiple states represent long-range interactions between secondary structures. This is the first experiment directly observing interactions of secondary structures to form tertiary structure using single molecule technique.

1997-2003 Massachusetts Institute of Technology Cambridge, MA
Advisor: Alan J Grodzinsky and Christine Ortiz

Research focuses on elucidating molecular mechanism of compressive resistance of cartilage by measuring interactions of glycosaminoglycan (GAG) molecules in cartilage directly using high resolution force spectroscopy. The highly charged GAG molecules were chemically end-grafted on the substrate and AFM probe tip forming a brush like layer under electric field between substrate and AFM probe tip. The measurement of nanoscale intermolecular forces between GAG layers showed a

significant dependence on various salt concentrations and pH's, which is a hallmark of the electrostatic interactions. Direct nanomechanical measurement was in excellent agreement with newly developed molecular level Poisson-Boltzmann model. Comparison of the nanomechanical data with data obtained from macroscopic tissue level measurement showed that electrostatic interactions between GAG molecules plays a significant role in compressive resistance of cartilage biomechanical properties at tissue level.

1996-1997 Hongik University Seoul, Korea
Advisor: Eugene Kim

Developed a numerical solution of diffusion at the interface between polystyrene and polycarbonate. The diffusion coefficient is composition dependent when they diffuse at the temperature between their glass temperatures. The model calculation explained the experimental data well quantitatively.

1993-1995 Seoul National University Seoul, Korea
Advisor: Tae O. Ahn and Kilwon Cho

Analyzed mechanical properties of highly crosslinked thermoset resin that was toughened by high performance thermoplastic resin. Improved shock absorbing properties of an extremely brittle thermoset with minimal decrease in other desirable properties creating phase separated structure. Explained the toughening mechanism of improved mechanical property.

Teaching Experience

Fall 1994 Seoul National University Seoul, Korea
Polymer engineering lab: Teaching Assistant
Supervised and assisted students with laboratory exercises: polymer synthesis by condensation reaction and characterization. Helped with exam and lab report grading.

Awards

Student Poster Award, American Chemical Society Meeting, Division of Colloid and Surface Chemistry, San Diego, 2001

Presentations

"Unfolding behavior of Rossmann fold integrin I domain measured directly using optical tweezer"; **J. Seog**, J. Dill, X. Zhang, C. Cecconi, M. Kim, M. Shimaoka, C. Bustamante, and T. Springer. Single Molecule Biophysics Winter Workshop, Aspen, CO. February 2007

"Structure-Function of MAdCAM-1 revealed by single-molecule force spectroscopy"; X. Zhang, **J. Seog**, and T.A. Springer. Experimental Biology, San Francisco, CA. April 2006

"Effect of solution conditions on nanoscale interactions between opposing glycosaminoglycan brushes"; **J. Seog**, D. Dean, S. Wong-Palms, A. Plaas, A. Grodzinsky, C. Ortiz. The Annual March Meeting of American Physical Society in Austin, TX. March 2003

"Measurement of GAG-GAG nano-electromechanical interactions via high resolution force spectroscopy"; **J. Seog**, E. Frank, D. Dean, S. Wong-Palms, A. Plaas, A. Grodzinsky, C. Ortiz. The Annual March Meeting of the American Physical Society in Indianapolis, IN. March 2002

“Measurement of GAG-GAG nano-electromechanical interaction using high resolution force spectroscopy”; **J. Seog**, E. Frank, D. Dean, A. Plaas, S. Wong-Palms, A. Grodzinsky, and C. Ortiz. 48th Annual Meeting of the Orthopedic Research Society in Dallas, TX. February 2002

“Modeling and measurement of glycosaminoglycan electrostatic interactions”; **J. Seog**, D. Dean, A. Plaas, S. Wong-Palms, A. Grodzinsky, and C. Ortiz. 221st American Chemical Society National Meeting in San Diego, CA. April 2001

“Cartilage molecular mechanics: detection of GAG electrostatic interactions by high-resolution force spectroscopy”; **J. Seog**, D. Dean, A. Plaas, S. Wong-Palms, I. Lee, P. Laibinis, A. Grodzinsky, and C. Ortiz. 47th Annual Meeting of the Orthopedic Research Society in San Francisco, CA. February 2001

Publications

1. “Nanomechanics of opposing glycosaminoglycan brushes” **J. Seog**, D. Dean, B. Rolauuffs, T. Wu, J. Genzer, A. H.K. Plaas, A. J. Grodzinsky and C. Ortiz. *Journal of Biomechanics* 2005; 38(6);1789-1797
2. “Preparation and characterization of end-grafted polyelectrolytes on nanoscale probe tips using an electric field” **J. Seog**, E. Frank, D. Dean, A. Grodzinsky, and C. Ortiz. *Macromolecules* 2004; 37(3); 1156-1158
3. “A New Molecular Level Theoretical Model for Electrostatic Interaction Within Polyelectrolyte Brushes Using Glycosaminoglycans as a Model System” D. Dean, **J. Seog**, C. Ortiz, and A. Grodzinsky. *Langmuir* 2003; 19(13); 5526-5539
4. “Direct Measurement of Glycosaminoglycan Intermolecular interactions via High-Resolution Force Spectroscopy” **J. Seog**, D. Dean, A. Plaas, S. Wong-Palms, A. Grodzinsky, and C. Ortiz. *Macromolecules* 2002; 35(14); 5601-5615; **Cited in Physics Today** 2002; 55(9); 21-23
5. “Morphology and toughening behavior of dially isophthalate resin/polyarylate alloy” Cho, K., **Seog**, J, and Ahn, T.O., *Polymer* 1996; 37(9); 1541-1549

Professional affiliations

Member of American Physical Society
Member of American Chemistry Society
Member of Biophysical Society