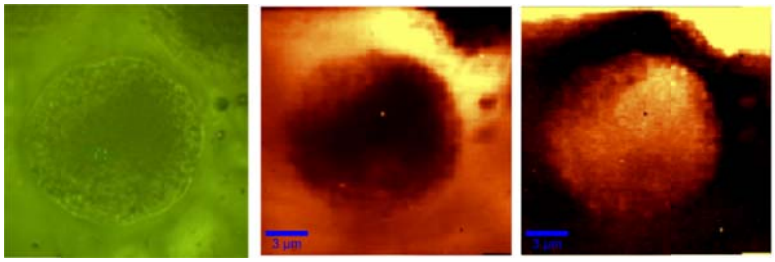
Available RA and Post-Doc Positions in Department of Mechanical Engineering in University of Minnesota

Molecular and cellular level analysis of the response of mammalian cells to desiccation/re-hydration and freeze/thaw



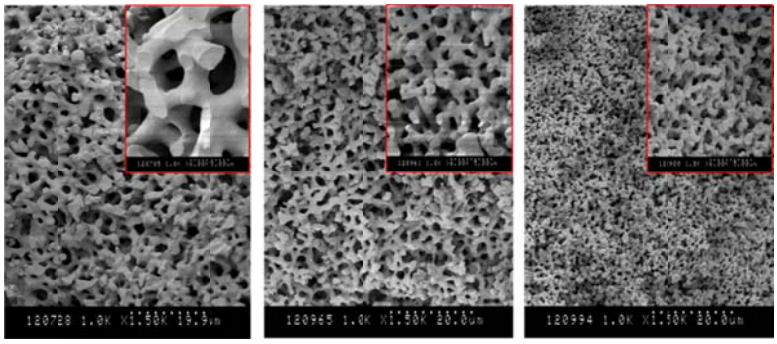
With the advances in technology it is now possible to directly determine the state of intracellular water and measure the kinetic and thermodynamic changes in single cells and sub-cellular components during freeze/thaw, desiccation/rehydration and vitrification. This research utilizes solution thermodynamics, Raman and FTIR spectroscopy, biology, cellular biophysics, as well as thermodynamic and kinetic modeling to determine the mechanisms of damage sustained by liposomes, bacteria and mammalian cells during thermal and osmotic interventions.

Related/Representative publications from our group:

- V. Ragoonanan, T. Wiedmann, A. Aksan, 2010 "Characterization of the Effect of NaCl and Trehalose on the Thermotropic Hysteresis of DOPC Lipids during Freeze/Thaw" Journal of Physical Chemistry B, doi:10.1021/jp103960r.
- V. Ragoonanan, A. Hubel, A. Aksan, 2010 "Freeze-Thaw Response of the Cell Membrane and the Cytoskeleton" Cryobiology, 61, 335-344.
- J. Dong, J. Malsam, J.C. Bischof, A. Hubel, A. Aksan, 2010 "Spatial Distribution of the State of Water in a Frozen Mammalian Cell" Biophysical Journal, 99, 8, 2453–2459.

Contact: Prof. Alptekin Aksan (aaksan@me.umn.edu) or Prof. Allison Hubel (hubel001@umn.edu)

Reactive hybrid biomaterial design, synthesis and characterization for bioremediation and biosensing



Silica sol-gel technologies enable development of synthetic-organic matrices that can be used as bioreactors, biosensors and biological batteries. This research is a collaboration between the BioTechnology Institute and the Mechanical Engineering Department in U of MN and utilizes biomaterials design, biotechnology, solution thermodynamics, interfacial analysis, and biomanufacturing to develop specific bioreactors to be used in bioremediation of water with specific emphasis on pesticide removal/neutralization.

Related/Representative publications from our group:

- E. Reategui, A. Aksan, 2010, "Effects of Water on the Structure and Low/High Temperature Stability of Confined Proteins," Physical Chemistry Chemical Physics, 12, 10161-10172.
- E. Reategui, A. Aksan, 2009, "Effects of the Kinetic and Thermodynamic Transitions of Confined Water on the Structures of Isolated and Cytoplasmic Proteins," Journal of Physical Chemistry B, 113, 39, 13048-13060.
- E. Reategui, A. Aksan, 2009, "Structural Changes in Confined Lysozyme," ASME Journal of Biomechanical Engineering, 131, 074520.

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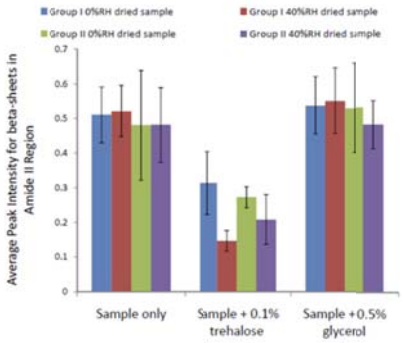
Available RA and Post-Doc Positions in Department of Mechanical Engineering in University of Minnesota

Stabilization and preservation of biospecimens



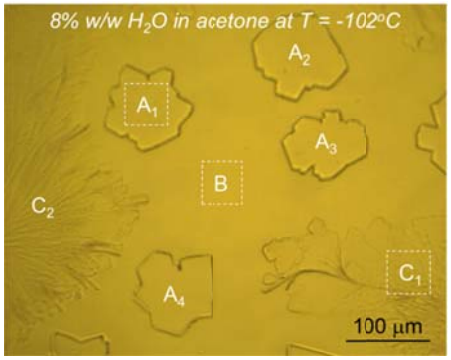
Conducted in collaboration with the Medical School at U of MN, this research utilizes biotransport, biothermodynamics, quantitative microscopy, biopreservation science and technologies to develop optimized and alternative biopreservation methods and techniques for biofluid biospecimens such as blood serum/plasma, urine, bronchoalveolar lavage lavage fluid and saliva. The research also extends to isolation and preservation of isolated and exfoliated cells and sub-cellular fragments in the fluid biospecimens.

Related/Representative publications from our group:

- A. Aksan, A. Hubel, J. Bischof, 2009, "Molecular-Level Phenomena in Biotransport" *ASME Journal of Biomechanical Engineering*, **131**, 074004.
- V. Ragoonanan, A. Aksan, 2008, "Heterogeneity in Desiccated Solutions: Implications for Biostabilization," *Biophysical Journal,* **94**, 6, 2212-2227.
- V. Ragoonanan, A. Aksan, 2007, "Preservation of Proteins: A Review," *Transfusion Medicine and Hemotherapy* **34**, 246-252.

Contact: Prof. Allison Hubel (hubel001@umn.edu)

Microheterogeneity, supercooling, and phase change analysis of aqueous solutions



This research utilizes IR and Raman spectroscopy, and solution thermodynamics, to determine the effects of water structural change, water-solute and water-interface interactions on the supercooling and phase change behaviors of aqueous solutions. The aims of this research also extend to establish the interactions of water with carbohydrates, with polar solvents and with the organic materials (such as macromolecules, lipids, etc.) in the solution. We also explore the mechanisms of microheterogeneity in the supercooled and the frozen states.

Related/Representative publications from our group:

- J. Malsam, A. Aksan, 2010, "Hydrogen Bonding Kinetics and Compartmentalization of Water in Supercooled Aqueous Acetone Solutions," Journal of Physical Chemistry B, 114, 12, 4238–4245.
- J. Dong, A. Hubel, J. Bischof, A. Aksan, 2009, "Freezing-Induced Phase Separation and Spatial Microheterogeneity in Protein Solutions," Journal of Physical Chemistry B, 113, 30, 10081-10087.
- J. Malsam, A. Aksan, 2009, "Hydrogen Bonding Kinetics of Water in High Concentration Trehalose Solutions at Cryogenic Temperatures," Journal of Physical Chemistry B, 113, 19, 6792-6799.

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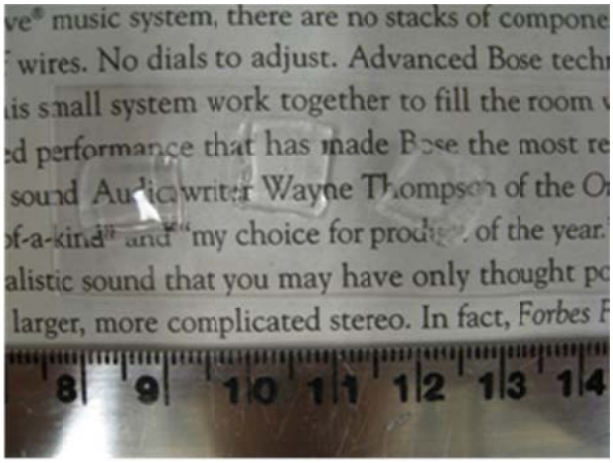
Available RA and Post-Doc Positions in Department of Mechanical Engineering in University of Minnesota



Hybrid biomaterial design and manufacturing

The main aim of this research is to design, characterize and manufacture passive biomaterials such as artificial skin, cornea etc. In collaboration with the Mayo Clinic in Rochester, MN, this research utilizes biomaterials, biomechanics, quantitative spectroscopy and interfacial analysis to construct an artificial cornea. The research extends to understanding how nanoconfinement and encapsulation can be utilized to induce self-assembly to construct artificial biomaterials that mimic nature.

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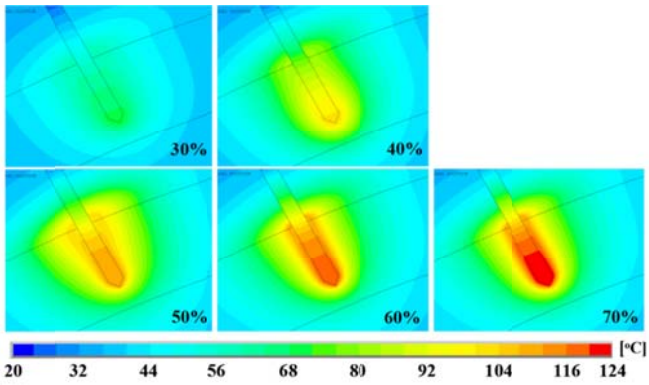
Macroscale biotransport and bioheat/mass transfer



The main aim of this research is to model and understand heat and mass transfer phenomena in biological systems. Of particular interest is measurement, quantification and modeling of the thermomechanical responses of collagenous soft tissues such as cornea, tendon, ligament and skin.

Related/Representative publications from our group:

- B. Jo, A. Aksan, 2010, "Prediction of the Extent of Thermal Damage in the Cornea during Conductive Keratoplasty," Journal of Thermal Biology, 35, 4, 167-174.
- T. Stylianopoulos, A. Aksan, V. H. Barocas, 2008, "A Structural, Kinetic Model of Soft Tissue Thermomechanics," Biophysical Journal, 94, 3, 717-725.
- L. Zhang, A. Aksan, 2010, "Thermal Modification of Human Cornea Tissue by Conductive Keratoplasty," Applied Spectroscopy, 64, 1, 23-29.

Contact: Prof. Alptekin Aksan (aaksan@me.umn.edu) or Prof. Allison Hubel (hubel001@umn.edu)