Research Opportunities in the Laboratory for Biomaterials, Drug Delivery and Bionanotechnology
Institute for Biomaterials, Drug Delivery, and Regenerative Medicine

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The University of Texas at Austin

2022 Engineering Graduate Student Orientation
Improving Medicine with Materials

New Website

https://www.peppamers.bme.utexas.edu/

The University of Texas at Austin

2022 Chemical Engineering Graduate Student Recruiting
Overview of Peppas Laboratory Research
Overview of Peppas Laboratory Research

Environmentally-responsive hydrogels for intelligent drug delivery and sensing applications

Andrew Murphy, NCSU ’17, NSF

Olivia Lanier, PhD U FL ‘21, Provost

Mariya Shevchuk, U Maryland ’18, NSF

Nate Richbourg, Univ Oklahoma’19 NSF

Jesus Rodriguez, TAMU ‘21, NSF

Deidra Ward, Clemson’19, NIH

Oral Protein Delivery

Oral Chemo-therapeutic Delivery

Oral siRNA Delivery

Molecular Recognition

Tissue Engineering

Polymer Theories

Andrew Murphy, NCSU ’17, NSF

Olivia Lanier, PhD U FL ‘21, Provost

Mariya Shevchuk, U Maryland ’18, NSF

Nate Richbourg, Univ Oklahoma’19 NSF

Jesus Rodriguez, TAMU ‘21, NSF

Deidra Ward, Clemson’19, NIH

Fabiola Chapa, Tec Monterrey’21, NSF

Heidi Oldenkamp, Oregon SU ’17, NSF

Dennis Huang, UPenn ’18, UT-Port

Aaliyah Shodeinde, Lafayette College’17, NIH

The University of Texas at Austin

IBDR | INSTITUTE FOR BIOMATERIALS, DRUG DELIVERY & REGENERATIVE MEDICINE
Overview of Peppas Laboratory Research

To use environmentally-responsive hydrogels for a variety of drug delivery and sensing applications

Benefits
• Target site specificity
• Reduced off-target side effects
• Protection of sensitive therapeutics

Challenges
• Disease model
• Choice of stimuli
• Material design
Oral Protein Delivery

Development of a pH-responsive system for the oral delivery of proteins to replace daily injections

Molecular Weight
- Insulin: 5.8 kDa
- hGH: 22 kDa
- Factor IX: 55 kDa

Hydrophobicity
- Chemotherapeutic Agents
  - Doxorubicin
  - Paclitaxel

Isoelectric Point
- Insulin: pI 5.4
- Humira: pI 8.1
- Calcitonin: pI 8.86
Bionanotechnology

Novel biomaterials that respond in a programmed manner to biological stimuli

Targeted Delivery and Theranostics

Externally Responsive Nanoparticles
- Gold-Polymer Nanoparticles
- Magnetic nanoparticles

Biologically-Triggered Nanoparticles

\[ \Delta \text{pH} \]
# Major Disease Targets and Therapeutics

<table>
<thead>
<tr>
<th>Disease</th>
<th>Therapeutics</th>
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<tbody>
<tr>
<td>Multiple Sclerosis</td>
<td>Interferon-β</td>
</tr>
<tr>
<td></td>
<td>HEIDI, FABIOLA</td>
</tr>
<tr>
<td>Crohn’s Disease</td>
<td>High Isoelectric Point Protein Drugs</td>
</tr>
<tr>
<td></td>
<td>HEIDI, OLIVIA</td>
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<tr>
<td>Cancer</td>
<td>Chemotherapy, siRNA, Interferon-α</td>
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<td></td>
<td>DENNIS</td>
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<tr>
<td>Ulcerative Colitis</td>
<td>siRNA</td>
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<tr>
<td></td>
<td>OLIVIA, AALIYAH</td>
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<tr>
<td>Glioblastoma</td>
<td>mRNA</td>
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<td></td>
<td>DEIDRA</td>
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<tr>
<td>Osteoporosis</td>
<td>Calcitonin</td>
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<tr>
<td>Macular Degeneration</td>
<td>Various</td>
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<tr>
<td></td>
<td>JESUS</td>
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<tr>
<td>Cancer</td>
<td>Various</td>
</tr>
<tr>
<td></td>
<td>DENNIS</td>
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Molecular Recognition

Functional monomers are polymerized in the presence of a biomolecule of interest. Following purification, these polymers have recognitive moieties. Applications include *low cost biosensors, drug delivery, and regenerative medicine*. 

![Diagram of molecular recognition process]
Nanoscale, synthetic polymers with molecular recognition properties for use in the design of *optical sensor arrays for diagnostic applications.*
Overview of Peppas Laboratory Research

Projects for Qualified BME and CHE PhD students

EXAMPLES

1. Two- and three-biomarker recognition systems for new biosensors to detect autoimmune diseases
2. Core/shell nanoparticles from novel biodegradable carriers for antibody delivery
3. Novel polymer networks for delivery
4. Diseases: Glioblastoma, multiple sclerosis, Crohn’s disease,
5. Cancer, Cardiovascular diseases
6. Fundamental studies in polymer networks
Peppas Laboratory

Laboratories in the Biomedical Engineering Building

1 Postdoc
10 Graduate Students
26 Undergraduate Students