Yuguo Lei, PhD
Assistant Professor
Chemical and Biomolecular Enginering
University of Nebraska, Lincoln,
NE, USA 68588-0643
(402)-472-5313
ylei14@unl.edu

Appointment

Assistant Professor, 2014- , Chemical & Biomolecular Engineering, University of Nebraska, Lincoln

Education

Postdoc, California Institute for Quantitative Biosciences, UC Berkeley
PhD, Chemical and Biomolecular Engineering, UCLA
MS, Molecular and Medical Pharmacology, UCLA School of Medicine
MPhil, Polymer Science, Hong Kong University of Science and Technology
BS, Chemistry, Peking University

Research Interests

Use engineering expertise and human pluripotent stem cell (hPSC) biology to resolve unsolved human health problems; Develop new concepts and technologies for addressing the significant challenges in the process from benchtop to bedside for hPSC-derived cells.

- hPSC-derived synthetic tissues for the next-generation regenerative medicine
- GMP compliant 3D culture system for the scalable production of stem cells and synthetic tissues
- Novel biomaterials mimicking the transitional extracellular matrixes for stem cell expansion and delivery
- Efficient combination stem cell therapies for various degenerative diseases (PD, HD, AD, ALS, SCI and MI)
- Synthetic 3D tissue arrays for high throughput drug discovery

Research Experience

University of California, Berkeley

- Developed a simple, efficient, defined and GMP compliant 3D culture system for human pluripotent stem cell (hPSC) expansion and differentiation. This system has the potential to change hPSC culture practices and to be the first cost-effective approach for producing clinical-grade cells from hPSCs at various scales, resolving a major challenge that currently limits the applications of hPSCs or their derivatives in drug discovery, tissue engineering and cell therapies.
- Created a completely defined, small-molecule-based protocol that can efficiently convert hPSCs into dopaminergic (DA) neurons within the 3D culture system, resulting in a GMP compliant bioprocess for making sufficient DA neurons for future clinical trials (~$10^{11\text{-}12}$ cells) and other industrial applications. These cells are currently being tested for treating Parkinson's in rats.
- Researched on engineering protein ligands for activating or inhibiting the canonical Wnt signaling.

University of California, Los Angeles

- Developed protease degradable hyarulonic acid hydrogels for stem cell culture and delivery; systematically studied the relationship between gel properties and stem cell behaviors; demonstrated their applications in 3D culturing MSCs, neural stem cells and vascular stem cells.
- Developed and demonstrated the concept of cell-mediated gene delivery. Non-viral gene delivery nanoparticles were loaded into protease degradable hydrogels. Cells were transfected only when they degraded the hydrogels and uptake nanoparticles around them.
- Developed a universal process for loading concentrated, un-aggregated and active polyplexes into various hydrogels (up to 5mg pDNA/mL hydrogel tested).
- Indentified the intracellular targets for three small molecule inhibitors of Rapamycin (SMIRs) using affinity chromatography plus protein mass spectrometry.

Shanghai Genius Advanced Materials Co., China
- Researched on antibacterial engineering plastics.
- Investigated the processing, microstructures and properties of PP/Nylon6 blends.

Hong Kong University of Science and Technology
- Systematically studied the early stages of polymer spherulitic crystal growth. The birth of the embryo nuclei, the growth & branching of the founding lamella were observed *in-situ* and *real time* **for the first time**.
- Investigated the surface segregation phenomenon of blend polymer materials using AFM, ToF-SIMS, XPS.

Peking University
Prepared several polyamine dendrimers, and attached peptide antigens to their surfaces to make structure-defined synthetic vaccines.

Publications

1. **Lei Y**, Xiao J, Jeong D, Conway A and Schaffer D, Scalable production of dopaminergic neurons and their application in treating Parkinson's disease in rats, *in preparation.*
2. **Lei Y**, Jeong D, Xiao J and Schaffer D, Developing Defined and Scalable 3D Culture Systems for Culturing Human Pluripotent Stem Cells at High Densities, *Cellular & Molecular Bioengineering.* 2014, 7 (2): 172 *(selected as the Outstanding Contribution to 2013 BMES meeting)*
3. **Lei Y** and Schaffer D, A fully defined and scalable 3D culture system for the production of human pluripotent stem cells and their progeny, ***PNAS,*** 2013 Nov 18.
4. Tokatlian T, Cam C, Siegman SN, **Lei Y**, Segura T, Design and characterization of microporous hyaluronic acid hydrogels for in vitro gene transfer to mMSCs, *Acta Biomater.* 2012 Nov;8(11):3921-31.
5. Zhang J, **Lei Y**, Dhaliwal A, Ng QK, Du J, Yan M, Lu Y, Segura T, Protein-polymer nanoparticles for nonviral gene delivery, *Biomacromolecules.* 2011 Apr 11;12(4):1006-14.
6. **Lei Y**, Rahim M, Ng Q and Segura T, Hyaluronic acid and fibrin hydrogels with concentrated DNA/PEI polyplexes for local gene delivery, *J Control Release.* 2011 Aug 10;153(3):255-61.
7. **Lei Y**, Gojggini S, Lam J and Segura T, The spreading, migration and proliferation of mouse mesenchymal stem cells cultured inside hyaluronic acid hydrogels, *Biomaterials.* 2011 Jan;32(1):39-47.
8. **Lei Y**, Huang S, Kashani PS, Chen Y, Kavehpour P and Segura T, Incorporation of active DNA/cationic polymer polyplexes into hydrogel scaffolds, *Biomaterials.* 2010 Dec;31(34):9106-16.
9. **Lei Y**, Ng Q and Segura T, Two and Three-dimensional gene transfer from enzymatically degradable hydrogel scaffolds*, Microsc Res Tech.* 2010 Sep; 73(9):910-7.
10. **Lei Y** and Segura T, DNA delivery from matrix metalloproteinase degradable poly(ethylene glycol) hydrogels to mouse cloned mesenchymal stem cells, *Biomaterials* 2009 30(2):254-65.
11. Weng LT, Ng KM, Cheung ZL, **Lei Y** and Chan CM, Quantitative analysis of styrene-pentafluorostyrene random copolymers by ToF-SIMS and XPS, *Surface and Interface Analysis* 2006 38(1): 32-43.
12. Ou YC, **Lei Y**, Fang XP, Yang GS, Maleic anhydride grafted thermoplastic elastomer (TPEg) as interfacial modifier for Polypropylene/Polyamide6 blends, *Journal of Applied Polymer Science* 2004 91:1806.
13. **Lei Y**, Chan CM, Ng KM, Jiang Y and Li L, Growth process of homogeneously and heterogeneously nucleated spherulites as observed by Atomic Force Microscopy ", *Polymer* 2003 44:4673.
14. **Lei Y**, Chan CM, Weng LT, Ng KM and Li L, Surface chemical and morphological properties of a blend containing semi-crystalline and amorphous polymers studied with ToF-SIMS, XPS and AFM, *Polymer* 2003 44:3883.
15. **Lei Y**, Chan CM, Weng LT and Ng KM, XPS C1s binding energies for fluorocarbon-hydrocarbon microblock polymers, *Surface and Interface Analysis* 2003 35:852.
16. **Lei Y**, Chan CM, Li JX, Ng KM, Jiang Y and Li L, The birth of an embryo and development of the founding lamella of spherulites as observed by Atomic Force Microscopy, *Macromolecules* 2002 35:6751.
17. Jiang Y, Gu Q, Li L, **Lei Y** and Chan CM, Structural changes during isothermal crystallization of a Poly(bisphenol A-co-Decane Ether) polymer, *Polymer* 2002 43: 5615-5621.

18. Chan CM, Li L, Ng KM, Li JX and **Lei Y**, Direct observation of growth of lamellae and spherulites of a semi-crystalline polymer by AFM, *Polymeric Materials Science and Engineering* 2002 86:389.
19. Luo YH, Jiang Y, **Lei Y**, Chan CM and Li L, Progress of polymer crystal growth studied with AFM, *Chinese Science Bulletin* 2002 47:1121-1125.
20. Li L, Chan CM, Yeung KL, Ng KM and **Lei Y**, Direct observation of growth of lamellae and spherulites of a semicrystalline polymer by AFM, *Macromolecules* 2001 34: 316-325.
21. Li L, Chan CM, **Lei Y** and Weng LT, A time-of-flight secondary ion mass spectrometry study of sequential polymers with a well-defined segmental length, *Polymer* 2001 42: 6841-6849.

Presentations and Posters

1. **Lei Y** and Schaffer D, A scalable 3D culture system for hPSCs expansion and differentiation, AICHE, San Francisco, 2013.
2. **Lei Y** and Schaffer D, Scalable production of dopaminergic neurons and their application in treating Parkinson's disease in rats, AICHE, San Francisco, 2013.
3. **Lei Y** and Schaffer D, A scalable 3D culture system for hPSCs expansion and differentiation, BMES, Seattle, 2013 (*selected as the* ***Outstanding Contribution to the Stem Cell Engineering Track***).
4. **Lei Y** and Schaffer D, A scalable 3D culture system for hPSCs expansion and differentiation, GRC Biomaterials and Tissue Engineering, Holderness, NH, 2013.
5. **Lei Y** and Schaffer D, Defined 3D culture system for hPSCs expansion and differentiation, UC Berkeley Stem Cell Center Retreat, California, 2013.
6. **Lei Y,** Rahim M and Segura T, Gene transfer in and from hydrogels, SFB 2010 Annual Meeting, Seattle, Washington, April 2010.
7. **Lei Y** and Segura T, Biodegradable hydrogels with concentrated pDNA/PEI polyplexes for tissue engineering and regeneration, AIChE, Nashville, TN, Nov 2009.
8. Zhang JJ, **Lei Y** and Segura T, Protein-polymer core-shell nanoparticles as non-viral gene delivery vehicles, AIChE, Nashville, TN, Nov 2009.
9. **Lei Y** and Segura T, Matrix metalloproteinase degradable PEG hydrogel with high DNA/PEI loading for tissue engineering, SFB 2009 Annual Meeting, Grand Hyatt San Antonio, San Antonio, Texas, April 2009.
10. **Lei Y** and Segura T, DNA delivery from enzymatically degradable synthetic hydrogels to invading cells results In sustained transgene expression, AIChE, Philadelphia Downtown Convention Center, Nov 2008.
11. Wang Y, Chan CM, Jiang Y, Li L, **Lei Y**, and Cheung ZL, Real-time study on lamellar branching by Atomic Force Microscopy, 225rd ACS National Meeting, MAR 2003.
12. Chan CM, Li L, Ng KM, Li JX and **Lei Y**, Direct observation of growth of lamellae and spherulites, 223rd ACS National Meeting, Orlando, FL, April 2002.
13. **Lei Y** and Schaffer D, A scalable 3D culture system for hPSCs expansion and differentiation, GRC Biomaterials and Tissue Engineering, Holderness, NH, 2013 (poster) (***won the Best Poster Award***).
14. **Lei Y**; Rahim M and Segura T, MMP degradable PEG hydrogel with high DNA/PEI loading for tissue engineering, GRC on Biomaterials, Holderness School in Holderness, NH, July 2009 (poster).

Awards and Honors

College of Engineering Junior Faculty Development Award, UNL, 2014
Outstanding Contribution to the Stem Cell Engineering Track, BMES Annual Meeting, 2013
Best Poster Award, GRC Biomaterials and Tissue Engineering, 2013
CIRM Postdoctoral Fellowship, California Institute of Regenerative Medicine, 2012, 2013
Siebel Postdoctoral Fellowship, Siebel Stem Cell Institute, 2011
Best Ph.D. in Chemical Engineering Award, UCLA, 2010
Outstanding Graduate, Peking University

Professional Activities

Member, American Institute of Chemical Engineers, 2006-present
Member, Society for Biomaterials, 2010-present
Member, Biomedical Engineering Society, 2012-present

Member, International Society for Stem Cell Research, 2011-present