Chih-Chang Chu

Web Bio

Information

Biography

Biographical Statement

Detailed information on Professor Chu can be found at
http://www.chu.human.cornell.edu/

Dr. C.C. Chu, the Rebecca Q. Morgan '60 Chaired Professor, joined the Cornell faculty in 1978 after completing postdoctoral research on biomaterials for maxillofacial prostheses at the Medical Center of the University of Alabama in Birmingham. He had held visiting appointments in the Department of Dental Science at University of Liverpool in the UK, at the National Yang-Ming Medical College in Taiwan, at Hahnemann University School of Medicine in Philadelphia and in the Division of Mechanics and Materials Science, Center for Devices and Radiological Health at the U.S. Food and Drug Administration. He has served on the editorial boards of The Open Macromolecules Journal, The Open Material Science Journal, The Open Biomaterials Journal, J. Fiber Bioengineering and Informatics, and J. Bioengineering and Biomedical Sci. He also served on the board of directors for the Society of Plastic Engineers (medical plastics division) and was on the editorial board of the Journal of Investigative Surgery. Dr. Chu is also the member of the Biology/Medicine Panel of Hong Kong Grant Research Council. Dr. Chu earned a B.S. in Chemistry from Tamkang University and a Ph.D. in polymer science from Florida State University.

Dr. Chu focuses on the study of biomaterials, particularly the design and synthesis of novel biodegradable polymers/fibers/fabrics for tissue regeneration and repair including vascular grafts, wound closure and drug control/release purposes. This also includes the design and evaluation of novel biologic active biodegradable polymers for surgical repair of injured, diseased or aged tissues, and their impact on wound infection and healing. In basis research, Dr. Chu's interests include the mechanisms of degradation of biomaterials, theoretical understanding of the effects of chemical structure on degradation through supercomputer molecular modeling, and exploring both intrinsic and extrinsic factors that could affect the degradation properties, such as the role of free radicals in degradation of biomaterials. His research activities also include the synthesis of new biodegradable polymers for immunotherapy of cancer patients, biomaterials for reducing restenosis of vascular stents, novel substrates for cell preservation and tissue engineering, biodegradable vascular grafts, functional wound closure biomaterials for eliminating wound infection during surgery and composite bone cement for orthopaedic surgery.

Dr. Chu has published over 185 research papers, a recipient of 64 US and international patents with many pending, an author and editor of the book “Wound Closure Biomaterials and Devices”. One of Chu’s new inventions 'Biodegradable, Bioactive, & Programable Hydrogels ' was chosen as a semifinalist for Discover Columbus Foundation Award competition. Dr. Chu has experience working with industry and medical professions to bring his new inventions in biomaterials to clinical reality. Dr. Chu teaches both undergraduate and graduate level courses. One course, “Biomaterials and Medical Devices for Human Body Repair”, nicknamed “Human Spare Parts”, is co-listed with the bioengineering curriculum, and has drawn students from all colleges at Cornell.

Teaching

Teaching and Advising Statement

Use a multidisciplinary approach and real examples to illustrate how biomaterials could be used in human body reconstruction. The latest research informations from my lab and others are introduced to students. Guest speakers from industry and medical communities may be invited to give students different perceptive of the multidisciplinary integration of the field.

Professional

Research

Current Research Activities

Biologically active bioabsorbable polymers and fibers: The goal is to design and synthesis of amino acid based biodegradable poly(ester amide)s that could have many different types of reactive sites for chemical conjugation with biologically active agents. These new PEAs can also be fabricated via electrospinning into nanofibers or photocrosslinking into 3D microporous hydrogels. These nanofibrous membranes and hydrogels will be inherent chemical functional groups for chemical attachment or pre-loading of biological agents for treating a variety of diseases.

Durg- or biologics-impregnated hydrogels for a vareity of clinical use: The goal is to design biodegradable hydrogels that can be fabricated in an aqueous medium and can carry biologics or drugs for their sustained release to treat a variety of diseases. One particular project involves the delivery of growth factors like bFGF for improved skin regneration of burn victims, and is collaborated with Prof. M. S. Jin of Dept. of Biomedical Engineering and Profs. R. Yurt/S. Schwartz of Weill Cornell Medical College.

Therapeutic biodegradable biomaterials for wound management of burn victims: The goal is to promote wound healing of burn victims by fabricating our new pseudo-amino acids into microfiber-based medical devices as artificial skins that would have the capability to release biological agents and would also have elastomeric mechanical property. This project is collaborated with Prof. Roger Yurt and Suzanne Schwartz of Cornell Burn Center and is funded by Cornell

University.

Biodegradable carriers for Gene and DNA: The goal is to design and develop new synthetic carriers that could improve gene transfection efficiency with better cellular biocompatibility. This work is collaborated with Prof. Bo Liu and Craig Kent of Division of Vascular Surgery of Dept. of Surgery of Weill Cornell Medical College and is supported by a seed grant from Cornell University.

Biodegradable polysaccharide-based biomaterials for bone engineering and as synthetic extracellular matrix: The goal is to design and develop a novel class of anionic biodegradable scaffold biomaterials that could provide bone biomineralization for engineering new bones for repair bones. This project is collaborated with the Hospital for Special Surgery, an afflilated of Weill Cornell Medical College.

Biodegradable scaffold for heart valve tissue engineering: This project is to use multidisciplinary approach to develop biodegradable and blood biocompatable scaffold via 3D bioprinting process so that heart value leaflets could be regenerated. The project involves Prof. J. Butcher of Dept. of Biomedical Engineering and Prof. Leo Girardi of Weill Cornell Medical College.

Biodegradable nanospheres for diagnostic and therpeutic of cancers: The goal is to design and develop biodegradable nanospheres that can be selectively uptaken by tumor cells for both diagnostic and therapeutic purpose. The project is collaborated with Prof. Rasa Zarengar of Weill Cornell Medical College.

Effect of supercritical CO_2 sterilization on synthetic absorbable biomaterials, a project via the collaboration with a local company, NovaSterilis.

Cationic biodegradable polymers for treating prostate cancer, a project via the cillaboration with Cornell Medical College.

Extension

Education

Education

- Postdoc 1978 - University of Alabama Chemistry
- Ph.D. 1976 - Florida State University Chemistry
- B.S. 1969 - Tamkang University, Taiwan, China Chemistry

Courses

Courses Taught

- BME 5390 - Biomedical materials and devices for human body repair
- FSAD 4360 - Fiber Chemistry
- FSAD 4390 - Biomedical Materials and Devices for Human Body Repair
- FSAD 6260 - The Chemistry of Textile Finishes and Dyeing

Websites

Related Websites

Personal Website
http://www.chu.human.cornell.edu/

Chu's Patents Listed on the Cornell Center for Technology, Enterprise and Commercialization Website
http://www.cctec.cornell.edu/technology/patents/humec_patents.php

Human Ecology website
http://www.human.cornell.edu/bio.cfm?netid=cc62

Administration

Publications

Selected Publications

Only those after 2010 are listed here:

1.

Mingyu He and **C. C. Chu**, "Dual Stimuli Responsive Glycidyl Methacrylate Chitosan-Quaternary Ammonium Hybrid Hydrogel and Its Bovine Serum Albumin Release", *J. Appl. Polym. Sci*, 130 (5): 3736-37845, (2013).

J. Liu, X.L. Liu, T.F. Xi, **C.C. Chu**, " A Pseudo-Protein-based Biodegradable Coating for Magnesium Substrate: In vitro corrosion phenomena and cytocompatibility," *J. Mater. Chem, Part B* (In Press).
5. 6. 7.

2. D. Q. Wu, J. Wu, and **C. C. Chu**, "A novel family of biodegradable hybrid hydrogels from arginine-based poly(ester amide) and hyaluronic acid precursors", *Soft Matter*, 9: 3965-3975, (2013)

3. Mingyu He and **C. C. Chu**, "A new family of functional biodegradable Arginine-based polymer urea urethanes: synthesis, characterization and biodegradation", *Polymer*, 54: 4112-4125 (2013)

4. X. H. Qin, D. Q. Wu, and **C. C. Chu**, "Dual functions of polyvinyl alcohol (PVA): fabricating particles and electrospinning nanofibers applied in controlled drug release", *J. Nanoparticle Res.*, 15: 1395 - 1409 (2013)

5. Jun Wu and **C. C. Chu**, "Water insoluble cationic poly (ester amide)s: synthesis, characterization and applications", *J. Mater. Chem.* B, 1:353 – 360, (2013)

6. C. S. Chen, X. D. Xu, Y. Wang, J. Yang, H. Z. Jia, H. Cheng, **C. C. Chu**, R. X. Zhuo, X. Z. Zhang, "A peptide nanofibrous indicator for eye-detectable cancer cell identification", *Small*, 9 (6): 920-926, (2013)

7. **C. C. Chu**, "Types and Properties of Surgical Sutures", IN: Biotextiles as Medical Implants, B.S. Gupta, M. King and R. Guidoin (eds), Woodhead Publishing Series in Textiles No. 113, Cambridge, England, Part 2 Application, Chapter 10, Oct. 2013, pp 232-274.

8. **C. C. Chu**, ""Materials for Absorbable and Non-absorbable Surgical Sutures", IN: Biotextiles as Medical Implants, B.S. Gupta, M. King and R. Guidoin (eds), Woodhead Publishing Series in Textiles No. 113, Cambridge, England, Part 2 Application, Chapter 11, Oct. 2013.

9. Jun Wu Dequn Wu Martha A. Mutschler, **Chih-Chang Chu**, "Cationic Hybrid Hydrogels from Amino-Acid-Based Poly(ester amide): Fabrication, Characterization, and Biological Properties", *Advanced Functional Materials*, 22 (18): 3815-3823 (2012).

10. Jun Wu and **Chih-Chang Chu, "**Block Copolymer of Poly (ester amide) and Polyesters: Synthesis, Characterization, and in vitro Cellular Response", *Acta Biomaterials*, 8 (12): 4314-4323, (2012).

11. Jun Wu, Dai Yamanouchi, Bo Liu and **C. C. Chu**, "Biodegradable Arginine-based Poly(ether ester amide)s as Non-viral DNA delivery Vector and their Structure – Function Study", *J. Mater. Chem.* 22: 18983 – 18991, (2012).

12. LA Hockaday, KH Kang, NW Colangelo, PYC Cheung, B Duan, E Malone, J Wu, LN Girardi, LJ Bonassar, H Lipson, CC Chu and JT Butcher, "Rapdi 3D printing of anatomically accurate and mechanically heterogeneous aortic valve hydrogel scaffolds", Biofabrication, 4 (3): 1-12, Sept (2012).

13. Yuan-Jia Pan, Yuan-Yuan Chen, Dong-Rui Wang, Chuan Wei, Jia Guo, Da-Ru Lu, **Chih-Chang Chu**, Chang-Chun Wang, "Redox/pH dual stimuli-responsive biodegradable nanohydrogels with varying responses to dithiothreitol and glutathione for controlled drug release", *Biomaterials* 33(27): 6570-6579, (2012).

14. K. Guo and **C. C. Chu**, "Synthesis and Characterization of Poly--caprolactone-containing Amino Acid-based Poly(ether ester amide)s", *J. Appl. Polym. Sci.* 125(1): 812-819, (2012).

15. H. Song and **C. C. Chu**, "Synthesis and Characterization of A New Family of Cationic Poly(ester amide)s and Their Biological Properties", *J. Appl. Polym. Sci.* 124 (5): 3840–3853, (2012).

16. Chao Zhong and **C. C. Chu**, Biomimetic Mineralization of Acid Polysaccharide-based Hydrogels: Towards Porous 3-Dimensional Bone-like Biocomposites", *J. Mater. Chem*, 22(13): 6080-6087, (2012)

17. H. Xu, J. Wu, **C. C. Chu**, M. L. Shuler, "Development of disposable PDMS micro cell culture analog devices with photopolymerizable hydrogel encapsulating living cells", *Biomed Microdevices*, 14:409-418, (2012).

18. **C. C. Chu**, "Novel Biodegradable Functional Amino Acid-based Poly(ester amide) Biomaterials: Design, Synthesis, Property and Biomedical Applications", *J. Fiber Bioengineering and Informatics*" 5(1): 1-31, (2012)

19. **C. C. Chu,** "Biodegradable Polymeric Biomaterials: An Updated Overview", IN: Biomaterials – Principles and Practices, Ed: Joyce Y. Wong, Joseph D. Bronzino, and Donald R. Peterson, CRC Press, Boca Raton, Fla, Dec. 6, 2012, Chapter 5.

20. J. T. Butcher, L. Hockaday, K. Kang, N. Colangelo, J. Wu and **C. C. Chu**, "High fidelity 3D tissue printing of scalable anatomically accurate living aortic valves," *Tissue Engineering Part A* **1 7**(3-4), 545 (2011)

21. Guoming Sun, **C. C. Chu**, "Biodegradable Nanospheres Self-Assembled from Complementary Hydrophilic Dextran Macromers", *Carbohydrate Polymers*, 86(2): 910-916, (2011).

22. E. Chkhaidze, D. Tugushi, D. Kharadze1, Z. Gomurashvili, **C. C. Chu**, R. Katsarava, "New unsaturated biodegradable poly(ester amide)s composed of fumaric acid, leucine and ,-alkylene diols", *J Macromol Sci Part A - Pure & Appl Chem*. 48(7): 544 -555, (2011).

23. Mingxiao Deng, Jun Wu, Cynthia A. Reinhart-King, and **C. C. Chu**, "Biodegradable Functional Poly(ester amide)s with Pendant Hydroxyl Functional Groups: Synthesis, Characterization, Fabrication and *In Vitro* Cellular Response", *Acta Biomaterials* 7:1504-1515, (2011).

24. Jun Wu, Martha A. Mutschler, **C. C. Chu, "**Synthesis and Characterization of Ionic Charged Water Soluble Arginine-based Poly (ester amide)", *J. Mater. Sci. Mater in Med.* 22:469–479, (2011)

25. Joshua A. Horwitz, Katrina M. Shum, Josephine C. Bodle, MingXiao Deng, **C. C. Chu**, Cynthia A. Reinhart-King, "Biological performance of biodegradable amino acid-based poly(ester amide)s: Endothelial cell adhesion and inflammation *in vitro*", *J. Biomed. Mater. Res. Part A*, 95: 371-380 (2010).

26. Huijun Wu, Jintu Fan, **C. C. Chu** and Jun Wu, "Electrospinning of small diameter 3-D nanofibrous tubular scaffolds with controllable nanofiber orientations for vascular grafts", *J Mater. Sci., Mater. In Med*, 21:3207-3215, (2010)

27. Chao Zhong and **C. C. Chu**, On the Origin of Amorphous Cores in Biomimetic $CaCO_3$ Spherulites: New Insights into Spherulitic Crystallization", *J. Crystal Growth and Design* 10 (12): 5043–5049, (2010).

28. Xuan Pang, Jun Wu, Cynthia Reinhart-King, and **C. C. Chu**, "Synthesis and characterization of functionalized water soluble cationic poly(ester amide)s", *J. Polym. Sci. Part A: Polymer Chemistry*, 48:

3758–3766. (2010).

29. Chao Zhong,, Jun Wu, C.A. Reinhart-King, **C. C. Chu**, “Synthesis, characterization and cytotoxicity of photo-crosslinked maleic chitosan-PEGDA hybrid hydrogels”, *Acta Biomaterials*, 6(10):3908-3918, (2010).

30. Xuan Pang and **C. C. Chu**, “Synthesis, Characterization and Biodegradation of Poly(ester amide)s based Hydrogels”, *Polymer*, 51: 4200-4210, (2010).

31. K. Guo and **C. C. Chu**, "Synthesis of Biodegradable Amino Acid-based Poly(ester amide) and Poly(ether ester amide) with Pendant Functional Groups",*J. Appl. Polym. Sci.* 117(6): 3386-3394, (2010).

33. Xuan Pang and **C. C. Chu**, "Synthesis, Characterization and Biodegradation of Functionalized Amino Acid-based Poly(ester amide)s", *Biomaterials, 31(14): 3745-3754, (2010).*

34. Guoming Sun and C. C. Chu, "Impregnation of Tubular Self-Assemblies into Dextran Hydrogels", Langmuir, 26(4): 2831-2838, (2010).

32. Guoming Sun and **C. C. Chu**, "Impregnation of Tubular Self-Assemblies into Dextran Hydrogels", *Langmuir*, 26(4): 2831-2838, (2010).

C. C. Chu, “Arginine based polyester amide / polysaccharide hydrogels and their biological response”, *Acta Biomaterial*, 10: 3098-3107, (2014).