COLLEGE OF ENGINEERING AND COMPUTER SCIENCE
FLORIDA ATLANTIC UNIVERSITY

Announces the Ph.D. Dissertation Defense of

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for the degree of Doctor of Philosophy (Ph.D.)

"3D-Printed Flexible Polymer Stents for Esophageal Malignancies"

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ABSTRACT OF DISSERTATION
3D-Printed Flexible Polymer Stents for Esophageal Malignancies
Palliation therapy for dysphagia using esophageal stents is the current treatment of choice for those patients with inoperable esophageal malignancies. However, the stents currently used in the clinical setting, regardless of the type of metal mesh or plastic mesh stents (covered/uncovered), may cause complications, such as tumor ingrowth and stent migration into the stomach. Furthermore, metal mesh stents have limited capacities of loading anti-cancer drugs. To effectively reduce/overcome those complications and enhance the efficacy of drug release, we designed and 3D-printed a tubular, flexible polymer stent with spirals, and then load anti-cancer drug, paclitaxel, on the stent for drug release. Non-spiral 3D-printed tubular and mesh polymer stents served as controls. The self-expansion and anti-migration properties, cytotoxicity, drug release profile, and cancer cell inhibition of the 3D-printed stent were fully characterized. Results showed the self-expansion force of the 3D-printed polymer stent with spirals was slightly higher than the stent without spirals. The anti-migration force of the 3D-printed stent with spirals was significantly higher than the anti-migration force of a non-spiral stent. Furthermore, the stent with spirals significantly decreased the migration distance compared to the migration distance of the non-spiral 3D-printed polymer stent. The in vitro cytotoxicity of the new stent was examined through the viability test of human esophagus epithelial cells, and results indicated that the polymer stent does not have any cytotoxicity. The results of in vitro cell viability of esophageal cancer cells further indicated that the paclitaxel in the spiral stent treated esophageal cancer cells much more efficiently than that in the mesh stent. Furthermore, the results of the in vitro drug release profile and drug permeation showed that the dense tubular drug-loaded

stent can efficiently delivered more paclitaxel through the esophageal mucosa/submucosa layers in a unidirectional way than mesh stent that delivered less paclitaxel to the esophageal mucosa/submucosa but more to the lumen. In summary, these results showed that the 3D-printed dense polymer stent with spirals has promising potential to treat esophageal malignancies.

BIOGRAPHICAL SKETCH

Born in Putian, Fujian, China
B.S., Fuzhou University, Fuzhou, Fujian, China,2011
M.S., Nanchang University, Nanchang, Jiangxi, China, 2013
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CONCERNING PERIOD OF PREPARATION
& QUALIFYING EXAMINATION

Time in Preparation: 2016

Qualifying Examination Passed: Fall 2015

Published Papers:

1) Maohua Lin, Negar Firoozi, Chi-Tay Tsai, Michael B.Wallace and Yunqing Kang, "3D-printed flexible polymer stents for potential applications in inoperable esophageal malignancies," Acta Biomaterialia, 83 (2018), pp. 119-129.
2) Xuesong Wang, Maohua Lin and Yunqing Kang, "Engineering Porous β-tricalcium Phosphate (β-TCP) Scaffolds with Multiple Channels to Promote Cell Migration, Proliferation, and Angiogenesis," ACS applied materials & interfaces, 11 (2019), pp. 9223-9232.
3) Yaorong Luo, Maohua Lin, Naigen Zhou, Haibin Huang, Chi-Tay Tsai and LangZhou, "Molecular dynamics simulation study of the microstructure of a-Si:H thin film grown by oblique-angle deposition," Physica B: Condensed Matter, 2018, 345, 80-85.
4) Zhenyi Wei, Yixu Yang, Jinchang Huang, Bo Wu, Baisheng Sa, Yeyan Huang, Shuliang Wang, Maohua Lin, Chi-Tay Tsai and Kewu Bai,"Prediction of site occupancy of C15 Laves phase at finite temperature based on quasi-harmonic approximation model," Intermetallics, 2018, 96, 33-40.
5) Disheng Ou, Xiongxin Zhou, Maohua Lin and Chi-Tay Tsai,"Singular solutions of truss size optimization for considering 3 fundamental frequency constrain," Archieves of Applied Mechanics, 2018, pp. 1-10.
6) Sahar Ramin Gul, Matiullah Khan, Yi Zeng, Maohua Lin, Bo Wu and Chi-Tay Tsai, "Electronic Band Structure Variations in the Ceria Doped Zirconia: A First Principles Study," Materials, 2018, 11, 1238.
7) Tao Yu, Maohua Lin, Bo Wu, Jintian Wang and Chi-Tay Tsai,"Balanced design for the feasible super rocket fuels: A first-principle study on gauche CHN7 and CHN3," Journal of Molecular Graphics and Modelling, 2018, 84, 10-17.
8) Maohua Lin, Xuesong Wang, Chi-Tay Tsai and Yunqing Kang , "A Novel 3D Bioprinting Design Method of Bioceramic Scaffolds for Bone Regeneration," ASME's International Mechanical Engineering Congress and Exposition, Nov. 9-15, 2018, Pittsburgh, PA, USA.
9) Maohua Lin, Qingde Chen, Yunqing Kang and Chi-Tay Tsai, "2D Transient Viscoplastic Model for Dislocation Generation of SiC by PVT Method," SEM 2016 Annual Conference and Exposition on Experimental and Applied Mechanics, June 6-9, 2016, Orlando, Florida, USA.
10) Maohua Lin, Yunqing Kang and Chi-Tay Tsai, "Transient Viscoplastic Model for Dislocation Generation of SiC by PVT Method," SEM 2015 Annual Conference and Exposition on Experimental and Applied Mechanics, June 8-10, 2015, Costa Mesa, California, USA.