CURRICULUM VITAE

王志光 教授

Professor Chih-Kuang Wang, Ph.D.

I. Personal data: Current Address: Department of Medicinal and Applied Chemistry, Kaohsiung Medical University

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II. Education:

1998 Ph.D. / Department of Materials Science and Engineering, National Cheng Kung University, Taiwan

1992 M.S. / Department of Materials Science and Engineering, National Cheng Kung University, Taiwan

1990 B.S. / Department of Materials Science, Feng Chia University, Taiwan

III. Current position and relevant experiences:

2014-present Professor, Department of Medicinal and Applied Chemistry, Kaohsiung Medical University, Taiwan

2014-present Vice Director / Orthopaedic Research Center, Kaohsiung Medical University

2021/9-present Vice president, Office for Operation of Industry and University Cooperation, Kaohsiung Medical University

1995/7-1995/9 Short-term research of doctoral student, Department of Materials Science and Engineering/Materials Research Center, Northwestern University, Evanston, IL, USA.

1998-2003 Researcher, Materials Research Laboratories, Industrial Technology Research Institute (ITRI), Taiwan

2003-2009 Assistant Professor, Department of Medicinal and Applied Chemistry, Kaohsiung Medical University, Taiwan

2009-2014 Associate Professor, Department of Chemistry, Kaohsiung Medical University, Taiwan

2015-2016 Leader / Division of Industry and University Cooperation, Office for Operation of Industry and University Cooperation, Kaohsiung Medical University

2016-2018 Leader / Innovation Incubation Center, Office for Operation of Industry and University Cooperation, Kaohsiung Medical University

2018-2021/8 Leader / Division of Industry and University Cooperation, Office for Operation of Industry and University Cooperation, Kaohsiung Medical

University

IV. Fields of specialty and interest:

1. Design and fabrication of new scaffold biomaterials for tissue engineering of bone, and cartilage
2. Polymeric micelle micro-, nano-particle system for drug/gene delivery
3. 3D additive manufacturing of bioceramic applied to the customized/personalized medical device.
4. Design of 3D-printed bioinks for tissue engineering skin regeneration and vessel graft

V. Honor & Award:

1. The Excellent Poster Award/ 2015 Biosensor Group of Annual Symposium on Biomedical Engineering and Technology
2. The Best Paper Award / 2015 Symposium on Engineering Medicine and Biology Applications
3. Award of Patent Proved (2012-2019)/ Kaohsiung Medical University
4. Outstanding Papers Award (2008-2010, 2013-2014)/ Kaohsiung Medical University
5. Excellent guidance teachers of Kaohsiung Medical University (2008)
6. The 13th national innovation award in the academic research category, Innovative ceramic additive manufacturing technology, institute for biotechnology and medicine industry, Taiwan, 2016/12/22.
7. Taiwan Innovation Technology Expo-Innovative Invention Award (Innovative ceramic additive manufacturing technology) of the Ministry of Science and Technology, 2018.
8. The 7th Campus Entrepreneurship Competition of Kaohsiung Medical University
9. Second place in the entrepreneurial group, 2018
10. The 16th national innovation progress award in the academic research category, Innovative ceramic additive manufacturing technology, institute for biotechnology and medicine industry, Taiwan, 2019/12/06.
11. The 17th national innovation progress award in the academic research category, Innovative ceramic additive manufacturing technology, institute for biotechnology and medicine industry, Taiwan, 2020/12/01.
12. 109-2 FITI Outstanding Entrepreneurship Award from the Ministry of Science and Technology (2 million venture funds), Ministry of Science and Technology, 2020/11/27.

13. "Cranial burr hole cover of 3D bioceramic bone graft substitute using the additive manufacturing method.", MOST Grant for Applied Research Incubation Project, 2021.
14. Award the "U-Start Plan for Innovation and Entrepreneurship" in the manufacturing technology category (500,000 NT dollars) and established a startup company, 2021/04/30.
15. The startup company achieved championship in the Incubates category at the 18th Strategies of Warring States Period National Innovation & Entrepreneurship Competition, 2023/07/03.

VI. Main research results

Prof. Chih-Kuang Wang (王志光) is the principle investigator (PI) of this sub-project, who is a staff member of the Department of Medicinal and Applied Chemistry and also the investigator performed in the Orthopaedic Research Center (ORC) at Kaohsiung Medical University (KMU). **Prof. Wang** also has been the senior research scholar of the ORC at KMU for 12 years. **Prof. Wang** and his research team conducted the studies of drug controlled release related researches and tissue engineering on bone and cartilage regeneration in these years. Besides the individual project from national science council (NSC) and KMU performed in the ORC, **Prof. Wang** has been conducted **3 phases of integrated projects from the Ministry of Economic Affairs** (one of the component projects under Technology Development Program for Academia; TDPA**).** Recently, **Prof. Wang have obtained the integrated project of additive manufacturing from Ministry of Science and Technology between 2016 and 2018, this is an extension of an important results from the Kaohsiung Medical University Aim for the Top Universities Grant.** However, who mainly design and fabricate scaffold biomaterials for tissue engineering of bone & cartilage and polymeric micelle micro-, nano-particle system for drug/gene delivery. From these studies, 5 **patents** have been acquired, **3 patents applications** are in process; more than 40 SCI journal papers have been published (and/or accepted) from 2008: for instance, **Biomaterials served as 3-D scaffold and/or drug carriers** have been developed and the findings have been published from **PI. Professor Wang** is the corresponding author or co-authors of these papers. The main results of these papers are as follows:

1. We have prepared microcomposites of a biodegradable polymer (PLGA) with hydroxyapatite as delivery carrier for BSA-mode drugs. These microcomposites were formed into microspheres by a water-in oil- in-water process. The microcomposites were capable of sequestering proteins; preventing their premature release. However, this invention also can encapsulate the hydrophobic drug. Therefore, we developed a locally administered formulation of simvastatin that is encapsulated in poly(lactic-co-

glycolic acid)/hydroxyapatite (SIM/PLGA/HAp) microspheres with controlled-release properties. The low dose of simvastatin released from SIM/PLGA/HAp enhanced initial callus formation, neovascularization, and cell ingrowth in the grafted bone, indicating that SIM/PLGA/HAp facilitates bone regeneration. From this technology, 2 SCI journal papers have been published, 2 patents have been acquired, and this technical content has been transferred to a company via a non-exclusive license.

2. We studied three different types of carriers used to entrap recombinant human bone morphogenetic protein-2 (rhBMP-2) in terms of their performance in osteonecrosis regeneration and creeping substitution in Balb/C mice. Our study has developed that an ideal releasing profile and constant concentration of rhBMP-2 can rescue osteonecrosis and improve bone healing. Besides, We also created novel methods to introduce porosity into a bioceramic are mainly based on the admixture of a combustible reverse thermo-responsive hydrogel that burns away during sintering and on the air bubbles generated during the mixing process that leave free spaces in the resulting object. The dual effects of bone growth factors from osteoconductive bioceramic and osteoinductive rhBMP-2carriers can have better bone formation than other groups in addition to better callus formation and significant neo-vascularization. The use of porous bioceramic scaffolds with controlled release rhBMP-2 carriers to support bone growth shows a wealth of potential clinical applications for the treatment of non-union fractures. From these technologies, 3 SCI journal papers have been published, 3 patent have been acquired, 1 patents applications are in process.

3. We investigated the enhancing effect of a hyaluronan (HA)-enriched microenvironment on human adipose derived stem cell (hADSC) chondrogenesis for articular cartilage tissue engineering. Our results suggest that HA-enriched microenvironment induces chondrogenesis in hADSCs, which may be beneficial in articular cartilage tissue engineering. Therefore, we develop the pre-fabricated porous PGP2/1 [poly(d,l-lactic acid-co-glycolic acid)(75/25) blended with polyethylenimine-grafted-poly(d,l-lactic acid-co-glycolic acid)(50/50) in a 2:1 ratio] scaffolds with 72.7% porosity and a 200–400-μm pore size were generated via the gas foaming/salt leaching method first. And then, the HA modified porous PGP2/1 (HA-PGP) scaffolds were used as the HA-enriched microenvironment, that HA-PGP scaffolds provide a microenvironment that induces chondrogenesis by chondrocytes and BMSCs, which may be beneficial for regenerating cartilage-like tissue in vivo with the microfracture technique. From these technologies, 3 SCI journal papers have been published.

4. We have introduced an automated rapid prototyping method (3D bioprinting) that allows the engineering of fully biological three-dimensional custom-shaped bone

scaffolds and osteochondral defect modules. Bioprinting of bone and osteochondral scaffolds were performed with the 3D Discovery® (Regen HU Ltd, Switzerland). However, we also have developed this technology of additive manufacturing for ceramic materials, which have been applied for three patents between 2016 and 2017. In addition, our group have also developed the new cross-linked hydrogel system which can promptly formed during deposition molding and enhance the chondrogenesis of ADSCs.

5. Developing a thermoresponsive hydrogel system has led to the creation of a new process for preparing porous bioceramic scaffolds. This innovation has been granted patents. In 2013, an international journal paper was published: J Mech Behav Biomed Mater, 27:64-76. Additionally, the characteristic of thermoresponsive hydrogels to uniformly contract under pressure, the team has developed a 3D bioceramic extrusion printing technology by incorporating ceramic powder. In 2019, the team further advanced by developing a process for light-curing thermoresponsive hydrogel bioceramic slurries, achieving more precise and complex ceramic structural components. This technology should initially undergo clinical validation with standardized specialized 3D bone graft substitutes before advancing customized and precise 3D bone grafting medical devices, thereby facilitating the development of emerging medical industries. In September 2023, Kaohsiung Medical University completed a NT$20 million technology valuation transfer to a startup company, facilitating subsequent commercialization. (Paper had been published in J. Biol. Eng., 17, 74, 2023, and the second paper is currently in progress.)

6. In the field of 3D bioprinting and tissue regeneration using biopolymer hydrogels, three relevant SCI papers have been published (J. Biol. Eng., 17, 74, 2023; Polymers, 14, 2003, 2022; Mater. Sci. Eng.: C, 124, 112072, 2021). Among them, the development of a 3D biomimetic hybrid hydrogel is mainly composed of hyaluronic acid methacryloyl and gelatin methacryloyl copolymers. Innovative incorporation of inorganic cross-linkers (acrylate functionalized nano-silica, acrylate functionalized reduced graphene oxide) and PEGDA is utilized to enhance the mechanical properties of the hybrid hydrogels and slow down the degradation rate within the biological system. This novel hybrid hydrogel system holds promise for enhancing chondrogenesis and repairing cartilage tissue. Additionally, patent protection for this hybrid biopolymer hydrogel system for cartilage generation has been obtained (Republic of China Patent No.: 798084).