



Dayong Gao, PhD (Mechanical Engineering)

Dr. Dayong Gao is a Professor of Mechanical Engineering and Adjunct Professor of Bioengineering at the University of Washington. His major research focuses on the following areas: (1) fundamental and applied cryobiology: revealing the mechanisms of cryoinjury to living biological systems at low temperatures, and development of optimal methods, novel technology, and instruments for long-term cryopreservation/banking of living cells, tissues, and organs for cellular and gene therapy, tissue engineering, regenerative medicine, and organ transplantation; (2) development of a new generation of artificial organs, especially artificial kidney and liver systems for treatment of end-stage kidney and liver failure; and (3) bio-instruments and micro/nano-sensors (BioMEMS) for rapid and cost-effective diagnosis of diseases with high sensitivity and specificity.

Professor Gao is well-known in the fields of cryobiology and cryobiomedical engineering with applications in cryopreservation, regenerative medicine, gene and cell therapy, bio-instruments, artificial organs, and organ transplantation. He has been elected as the Present-Elect and Fellow of the Society for Cryobiology (International Society for Low Temperature Biology and Medicine) in

2016. He served as Chairman of the 2004 World Conference in Cryobiology and Cryomedicine, Co-Chairman of the 1996 Annual Society for Cryobiology Conference, and will serve again as Chairman of the International Conference of Cryobiology and Biobanking in 2017. In addition, Dr. Gao has actively collaborated with hospitals and corporations since 1991 to support and promote biobanking in medical practice and cell-tissue transplantation, and successfully developed new techniques, protocols, and instruments for long-term cryopreservation of human sperm/oocytes/ovarian tissues, pancreatic islets, skins, arteries, corneas, bone marrow and umbilical cord blood-derived hematopoietic stem cells, platelets, adipose cells/tissues/stem cells, and engineered tissues, etc.

Mechanical Engineering 3900 E Stevens Way NE, MED 254 Seattle, WA 98195

P: 206.543.1411 F: 206.685.8047 E: dayong@uw.edu

Research Interests:

Fundamental and applied cryobiology

Development of a new generation of artificial organs

Bio-instruments and micro/nano-sensors (BioMEMS)

Education & Training: B.Sc. in Mechanical Engineering University of Science and Technology of China (USTC)

Ph.D. in Mechanical Engineering, Concordia University, Montreal, Canada

Published articles:

TITLE

Mechanisms of cryoinjury in living cells

D Gao, JK Critser

ILAR journal 41 (4), 187-196

Andrology: prevention of osmotic injury to human spermatozoa during addition and removal of glycerol

TITLE

DY Gao, J Liu, C Liu, LE McGann, PF Watson, FW Kleinhans, P Mazur, ...
Human Reproduction 10 (5), 1109-1122

Effect of cryoprotectant solutes on water permeability of human spermatozoa

JA Gilmore, LE McGann, J Liu, DY Gao, AT Peter, FW Kleinhans, ...
Biology of reproduction 53 (5), 985-995

Hyperosmotic tolerance of human spermatozoa: separate effects of glycerol, sodium chloride, and sucrose on spermolysis

DY Gao, E Ashworth, PF Watson, FW Kleinhans, P Mazur, JK Critser
Biology of reproduction 49 (1), 112-123

Fundamental cryobiology of mammalian spermatozoa

D Gao, P Mazur, JK Critser
Reproductive tissue banking, 263-328

Cryopreservation of human spermatozoa. IV. The effects of cooling rate and warming rate on the maintenance of motility, plasma membrane integrity, and mitochondrial function

MA Henry, EE Noiles, D Gao, P Mazur, JK Critser
Fertility and sterility 60 (5), 911-918

Determination of optimal cryoprotectants and procedures for their addition and removal from human spermatozoa.

JA Gilmore, J Liu, DY Gao, JK Critser
Human reproduction (Oxford, England) 12 (1), 112-118

The viability of fatty tissues within adipose aspirates after conventional liposuction: a comprehensive study

LLQ Pu, X Cui, BF Fink, ML Cibull, D Gao
Annals of plastic surgery 54 (3), 288-292

Thermoelectric modules and a heating and cooling apparatus incorporating same

J Saunders, JD Jacob, D Gao, MA Myers
US Patent 6,739,138

Cryopreservation: An emerging paradigm change

JG Baust, D Gao, JM Baust
Organogenesis 5 (3), 90-96

Low-molecular weight proteins in end-stage renal disease: potential toxicity and dialytic removal mechanisms

WR Clark, D Gao
Journal of the American Society of Nephrology 13 (suppl 1), S41-S47

Dose determinants in continuous renal replacement therapy

WR Clark, JE Turk, MA Kraus, D Gao
Artificial organs 27 (9), 815-820

TITLE

Development of a novel microperfusion chamber for determination of cell membrane transport properties

DY Gao, CT Benson, C Liu, JJ McGrath, ES Critser, JK Critser
Biophysical journal 71 (1), 443-450

The promise of organ and tissue preservation to transform medicine

S Giwa, JK Lewis, L Alvarez, R Langer, AE Roth, GM Church, ...
Nature biotechnology 35 (6), 530

Hematopoietic SCT with cryopreserved grafts: adverse reactions after transplantation and cryoprotectant removal before infusion

Z Shu, S Heimfeld, D Gao
Bone marrow transplantation 49 (4), 469

Effect of blood flow and metabolism on multidimensional heat transfer during cryosurgery

G Zhao, HF Zhang, XJ Guo, DW Luo, DY Gao
Medical engineering & physics 29 (2), 205-215

Platelet retraction force measurements using flexible post force sensors

XM Liang, SJ Han, JA Reems, D Gao, NJ Sniadecki
Lab on a Chip 10 (8), 991-998

Kinetic comparison of different acute dialysis therapies

Z Liao, W Zhang, PA Hardy, CK Poh, Z Huang, MA Kraus, WR Clark, ...
Artificial organs 27 (9), 802-807

Membrane transport properties of mammalian oocytes: a micropipette perfusion technique

DY Gao, JJ McGrath, J Tao, CT Benson, ES Critser, JK Critser
Reproduction 102 (2), 385-392

Glycerol permeability of human spermatozoa and its activation energy

DY Gao, P Mazur, FW Kleinhans, PF Watson, EE Noiles, JK Critser
Cryobiology 29 (6), 657-667

Novel microwave technology for cryopreservation of biomaterials by suppression of apparent ice formation

TH Jackson, A Ungan, JK Critser, D Gao
Cryobiology 34 (4), 363-372

Universal model for intracellular ice formation and its growth

G Zhao, D Luo, D Gao
AIChE Journal 52 (7), 2596-2606

Method and device for gastric line insertion

RJ Demeter, HC Bock, D Gao
US Patent 5,611,787

TITLE

Properties of membranes used for hemodialysis therapy

WR Clark, D Gao

Seminars in Dialysis 15 (3), 191-195

Fundamental cryobiology of human hematopoietic progenitor cells I: Osmotic characteristics and volume distribution

DY Gao, Q Chang, C Liu, K Farris, K Harvey, LE McGann, D English, ...

Cryobiology 36 (1), 40-48

Innovation in the treatment of uremia: proceedings from the Cleveland Clinic workshop: blood-membrane interactions during dialysis

Z Huang, D Gao, JJ Letteri, WR Clark

Seminars in dialysis 22 (6), 623-628

Cryopreservation of human adipose tissues

XD Cui, DY Gao, BF Fink, HC Vasconez, LLQ Pu

Cryobiology 55 (3), 269-278

Adipose aspirates as a source for human processed lipoaspirate cells after optimal cryopreservation

LLQ Pu, X Cui, BF Fink, D Gao, HC Vasconez

Plastic and reconstructive Surgery 117 (6), 1845-1850

Immunosensor towards low-cost, rapid diagnosis of tuberculosis

JH Kim, WH Yeo, Z Shu, SD Soelberg, S Inoue, D Kalyanasundaram, ...

Lab on a Chip 12 (8), 1437-1440

The interactions between cysteamine, cystine and cumulus cells increase the intracellular glutathione level and developmental capacity of goat cumulus-denuded oocytes.

P Zhou, YG Wu, Q Li, GC Lan, G Wang, D Gao, JH Tan

Reproduction (Cambridge, England) 135 (5), 605-611

Evaluation of nano-porous alumina membranes for hemodialysis application

AC Attaluri, Z Huang, A Belwalkar, W Van Geertruyden, D Gao, ...

ASAIO journal 55 (3), 217-223

Method to quickly add cryoprotectants to sperm cells while maintaining viability

JK Critser, DY Gao

US Patent 5,691,133

Water and DMSO membrane permeability characteristics of in-vivo-and in-vitro-derived and cultured murine oocytes and embryos.

RT Pfaff, J Liu, D Gao, AT Peter, TK Li, JK Critser

Molecular human reproduction 4 (1), 51-59

Improving the blood compatibility of ion-selective electrodes by employing poly (MPC-co-BMA), a copolymer containing phosphorylcholine, as a membrane coating

TITLE

MJ Berrocal, RD Johnson, IHA Badr, M Liu, D Gao, LG Bachas
Analytical chemistry 74 (15), 3644-3648

Fracture phenomena in an isotonic salt solution during freezing and their elimination using glycerol

DY Gao, S Lin, PF Watson, JK Critser
Cryobiology 32 (3), 270-284

Determination of human platelet membrane permeability coefficients using the Kedem-Katchalsky formalism: estimates from two-vs three-parameter fits

EJ Woods, J Liu, JA Gilmore, TJ Reid, DY Gao, JK Critser
Cryobiology 38 (3), 200-208

Long-term preservation of adipose aspirates after conventional lipoplasty

LLQ Pu, X Cui, BF Fink, ML Cibull, D Gao
Aesthetic surgery journal 24 (6), 536-541

Water permeability and its activation energy for individual hamster pancreatic islet cells

C Liu, CT Benson, D Gao, BW Haag, LE McGann, JK Critser
Cryobiology 32 (5), 493-502

Generation of annexin V-positive platelets and shedding of microparticles with stimulus-dependent procoagulant activity during storage of platelets at 4° C

HY Xiao, H Matsubayashi, DP Bonderman, PW Bonderman, T Reid, ...
Transfusion 40 (4), 420-427

Development of optimal techniques for cryopreservation of human platelets: I. Platelet activation during cold storage (at 22 and 8° C) and cryopreservation

DY Gao, K Neff, HY Xiao, H Matsubayashi, XD Cui, P Bonderman, ...
Cryobiology 38 (3), 225-235

Healing of combined injuries of the rabbit medial collateral ligament and its insertions: a long term study on the effects of conservative vs. surgical treatment

KJ Ohland, SLY Woo, JA Weiss, S Takai, FJ Shelley
The Winter Annual Meeting of the American Society of Mechanical Engineers ...

Measurement of hollow fiber membrane transport properties in hemodialyzers

Z Liao, E Klein, CK Poh, Z Huang, J Lu, PA Hardy, D Gao
Journal of membrane science 256 (1-2), 176-183

High water permeability of human spermatozoa is mercury-resistant and not mediated by CHIP28

C Liu, D Gao, GM Preston, LE McGann, CT Benson, ES Critser, JK Critser
Biology of reproduction 52 (4), 913-919

Effect of flow baffles on the dialysate flow distribution of hollow-fiber hemodialyzers: a noninvasive experimental study using MRI

TITLE

CK Poh, PA Hardy, Z Liao, Z Huang, WR Clark, D Gao
Journal of biomechanical engineering 125 (4), 481-489

Equations for obtaining melting points for the ternary system ethylene glycol/sodium chloride/water and their application to cryopreservation

EJ Woods, MAJ Zieger, DY Gao, JK Critser
Cryobiology 38 (4), 403-407

Optimizing viable leukocyte sampling from the female genital tract for clinical trials: an international multi-site study

LR McKinnon, SM Hughes, SC De Rosa, JA Martinson, J Plants, ...
PloS one 9 (1), e85675

Development of a microfluidic device for determination of cell osmotic behavior and membrane transport properties

H Chen, JJP Purtteman, S Heimfeld, A Folch, D Gao
Cryobiology 55 (3), 200-209

Nanoporous alumina membranes for enhancing hemodialysis

Z Huang, W Zhang, J Yu, D Gao
Journal of Medical Devices 1 (1), 79-83

Cord blood stem cell cryopreservation

EJ Woods, KE Pollok, MA Byers, BC Perry, J Purtteman, S Heimfeld, ...
Transfusion Medicine and Hemotherapy 34 (4), 276-285

Determination of thermal conductivity of biomaterials in the temperature range 233–313K using a tiny detector made of a self-heated thermistor

H Zhang, S Cheng, L He, A Zhang, Y Zheng, D Gao
Cell Preservation Technology 1 (2), 141-147

Reducing the thrombogenicity of ion-selective electrode membranes through the use of a silicone-modified segmented polyurethane

MJ Berrocal, IHA Badr, D Gao, LG Bachas
Analytical chemistry 73 (21), 5328-5333

Operational characteristics of continuous renal replacement modalities used for critically ill patients with acute kidney injury

Z Huang, JJ Letteri, WR Clark, C Ronco, D Gao
The International journal of artificial organs 31 (6), 525-534

Simulation of removing permeable cryoprotective agents from cryopreserved blood with hollow fiber modules

W Ding, J Yu, E Woods, S Heimfeld, D Gao
Journal of membrane science 288 (1-2), 85-93

TITLE

Effect of spacer yarns on the dialysate flow distribution of hemodialyzers: a magnetic resonance imaging study

CK Poh, PA Hardy, Z Liao, Z Huang, WR Clark, D Gao
Asaio Journal 49, 440-448

The use of magnetic resonance imaging to measure the local ultrafiltration rate in hemodialyzers

PA Hardy, CK Poh, Z Liao, WR Clark, D Gao
Journal of membrane science 204 (1-2), 195-205

Glucose metabolism in mouse cumulus cells prevents oocyte aging by maintaining both energy supply and the intracellular redox potential

Q Li, DQ Miao, P Zhou, YG Wu, D Gao, DL Wei, W Cui, JH Tan
Biology of reproduction 84 (6), 1111-1118

Double porous media model for mass transfer of hemodialyzers

W Ding, L He, G Zhao, H Zhang, Z Shu, D Gao
International Journal of Heat and Mass Transfer 47 (22), 4849-4855

Cell-type-specific methods and devices for the low temperature preservation of the cells of an animal species

D Gao, JK Critser
US Patent 6,054,287

Solidification processes of solutions

R Viskanta, MVA Bianchi, JK Critser, D Gao
Cryobiology 34 (4), 348-362

A dual-thermistor probe for absolute measurement of thermal diffusivity and thermal conductivity by the heat pulse method

H Zhang, L He, S Cheng, Z Zhai, D Gao
Measurement Science and Technology 14 (8), 1396

Thermal stresses induced by water solidification in a cylindrical tube

S Lin, DY Gao, XC Yu
Journal of Heat Transfer (Transactions of the ASME (American Society of ...

Development of a reliable low-cost controlled cooling rate instrument for the cryopreservation of hematopoietic stem cells

Z Shu, X Kang, H Chen, X Zhou, J Purtteman, D Yadock, S Heimfeld, ...
Cytotherapy 12 (2), 161-169

A microfluidic study of mouse dendritic cell membrane transport properties of water and cryoprotectants

H Chen, H Shen, S Heimfeld, KK Tran, J Reems, A Folch, D Gao
International Journal of Heat and Mass Transfer 51 (23-24), 5687-5694

TITLE

Magnetoelastic transducers for monitoring coagulation, clot inhibition, and fibrinolysis

LG Puckett, JK Lewis, A Urbas, X Cui, D Gao, LG Bachas
Biosensors and Bioelectronics 20 (9), 1737-1743

Coupled transport across the murine oocyte plasma membrane: water and cryoprotective agents

JJ McGrath, DY Gao, J Tao, C Benson
ASME-PUBLICATIONS-HTD 206, 1-1

The pertinence of expression of heat shock proteins (HSPs) to the efficacy of cryopreservation in HELAs

P Wang, Z Shu, L He, X Cui, Y Wang, D Gao
CryoLetters 26 (1), 7-16

A numerical and experimental study of mass transfer in the artificial kidney

Z Liao, CK Poh, Z Huang, PA Hardy, WR Clark, D Gao
Journal of biomechanical engineering 125 (4), 472-480

Hydraulic Conductivity (L_p) and Its Activation Energy (E_a), Cryoprotectant Agent Permeability (P_s) and Its E_a , and Reflection Coefficients (ζ) for Golden Hamster Individual ...

CT Benson, C Liu, DY Gao, ES Critser, JD Benson, JK Critser
Cryobiology 37 (4), 290-299

Determination of the osmotic characteristics of hamster pancreatic islets and isolated pancreatic islet cells

CT Benson, C Liu, DY Gao, ES Critser, JK Critser
Cell transplantation 2 (6), 461-465

A dilution-filtration system for removing cryoprotective agents

X Zhou, Z Liu, Z Shu, W Ding, P Du, JH Chung, C Liu, S Heimfeld, D Gao
Journal of Biomechanical Engineering 133 (2), 021007

Freeze-drying of human red blood cells: influence of carbohydrates and their concentrations

J Yu, JH Liu, LQ Pu, X Cui, C Wang, SL Ouyang, D Gao
Cell Preservation Technology 2 (4), 270-275

An experimental study of the mechanical behavior of frozen arteries at low temperatures

A Zhang, S Cheng, D Lei, L He, D Luo, D Gao
CryoLetters 23 (6), 389-396

A steady-state mass transfer model of removing CPAs from cryopreserved blood with hollow fiber modules

W Ding, X Zhou, S Heimfeld, JA Reems, D Gao
Journal of biomechanical engineering 132 (1), 011002

Cryopreservation of adipose tissues: the role of trehalose

LLQ Pu, X Cui, BF Fink, ML Cibull, D Gao

TITLE

Aesthetic surgery journal 25 (2), 126-131

Numerical simulation of the effect of superparamagnetic nanoparticles on microwave rewarming of cryopreserved tissues

T Wang, G Zhao, XM Liang, Y Xu, Y Li, H Tang, R Jiang, D Gao
Cryobiology 68 (2), 234-243

Trapped water of human erythrocytes and its application in cryopreservation

G Zhao, L He, H Zhang, W Ding, Z Liu, D Luo, D Gao
Biophysical chemistry 107 (2), 189-195

Combined electromagnetic and heat-conduction analysis of rapid rewarming of cryopreserved tissues

CC Lu, HZ Li, D Gao
IEEE Transactions on Microwave Theory and Techniques 48 (11), 2185-2190

Artificial ground freezing of fully saturated mucky clay: Thawing problem by centrifuge modeling

J Zhou, Y Tang
Cold Regions Science and Technology 117, 1-11

Active contour-based cell segmentation during freezing and its application in cryopreservation

P Wu, J Yi, G Zhao, Z Huang, B Qiu, D Gao
IEEE Transactions on Biomedical Engineering 62 (1), 284-295

Dielectrophoretic concentration of low-abundance nanoparticles using a nanostructured tip

WH Yeo, AM Kopacz, JH Kim, X Chen, J Wu, D Gao, KH Lee, WK Liu, ...
Nanotechnology 23 (48), 485707

Added-mass effect in modeling of cilia-based devices for microfluidic systems

J Kongthon, B McKay, D Iamratanakul, K Oh, JH Chung, J Riley, ...
Journal of Vibration and Acoustics 132 (2), 024501

Size-selective immunofluorescence of Mycobacterium tuberculosis cells by capillary-and viscous forces

WH Yeo, FL Chou, G Fotouhi, K Oh, BT Stevens, HY Tseng, D Gao, ...
Lab on a Chip 10 (22), 3178-3181

The fate of cryopreserved adipose aspirates after in vivo transplantation

LLQ Pu, X Cui, J Li, BF Fink, ML Cibull, D Gao
Aesthetic surgery journal 26 (6), 653-661

Quantification of cell viability and rapid screening anti-cancer drug utilizing nanomechanical fluctuation

S Wu, X Liu, X Zhou, XM Liang, D Gao, H Liu, G Zhao, Q Zhang, X Wu
Biosensors and Bioelectronics 77, 164-173

TITLE

Cryopreservation of Mycobacterium tuberculosis complex cells

Z Shu, KM Weigel, SD Soelberg, A Lakey, GA Cangelosi, KH Lee, ...
Journal of clinical microbiology 50 (11), 3575-3580

Cryopreservation and microsurgical implantation of rabbit carotid arteries

X Cui, C Labarrere, L He, S Cheng, H Siderys, R Kovacs, D Gao
Cell Preservation Technology 1 (2), 121-128

General method to quickly remove cryoprotectants from animal cells while maintaining viability

JK Critser, DY Gao
US Patent 5,700,632

Update on cryopreservation of adipose tissue and adipose-derived stem cells

Z Shu, D Gao, LLQ Pu
Clinics in plastic surgery 42 (2), 209-218

Theoretical investigations of a novel microfluidic cooling/warming system for cell vitrification cryopreservation

X Zhou, Z Liu, XM Liang, Z Shu, P Du, D Gao
International Journal of Heat and Mass Transfer 65, 381-388

Determination of cell volume during equilibrium freezing process

G Zhao, L He, P Wang, W Ding, X Xie, Z Liu, H Zhang, Z Shu, D Luo, ...
Chinese Science Bulletin 48 (15), 1551-1554

Cryopreservation of composite tissues and transplantation: preliminary studies

X Cui, DY Gao, BF Fink, HC Vasconez, B Rinker
Cryobiology 55 (3), 295-304

Development of a single mode electromagnetic resonant cavity for rewarming of cryopreserved biomaterials

D Luo, C Yu, L He, C Lu, D Gao
Cryobiology 53 (2), 288-293

Comparative study of the cryosurgical processes with two different cryosurgical systems: the endocare cryoprobe system versus the novel combined cryosurgery and hyperthermia system

G Zhao, DW Luo, ZF Liu, DY Gao
Latin American applied research 37 (3), 215-222

A new method to increase the adsorption of protein-bound toxins in artificial liver support systems

W Ding, L Zou, S Sun, W Li, D Gao
Artificial organs 38 (11), 954-962

Rapid extraction and preservation of genomic DNA from human samples

D Kalyanasundaram, JH Kim, WH Yeo, K Oh, KH Lee, MH Kim, SM Ryew, ...

TITLE

Analytical and bioanalytical chemistry 405 (6), 1977-1983

Theoretical estimation of shell-side mass transfer coefficient in randomly packed hollow fiber modules with polydisperse hollow fiber outer radii

W Ding, D Gao, Z Wang, L He

Journal of membrane science 284 (1-2), 95-101

A microfluidic study of megakaryocytes membrane transport properties to water and dimethyl sulfoxide at suprazero and subzero temperatures

HY Tseng, S Sun, Z Shu, W Ding, JA Reems, D Gao

Biopreservation and biobanking 9 (4), 355-362

Particle enrichment employing grooved microfluidic channels

HH Chen, D Gao

Applied Physics Letters 92 (17), 173502

A new method to evaluate the local clearance at different annular rings inside hemodialyzers

Z Huang, E Klein, B Li, C Poh, Z Liao, WR Clark, D Gao

Asaio Journal 49 (6), 692-697

A modified differential scanning calorimetry for determination of cell volumetric change during the freezing process

D Luo, X Han, L He, X Cui, S Cheng, C Lu, J Liu, D Gao

CryoLetters 23 (4), 229-236