

Forrest M. Kievit, PhD

Assistant Professor

Department of Biological Systems Engineering

University of Nebraska - Lincoln

Office: 402-472-2175, Cell: 206-919-0262

Email: fkievit2@unl.edu

Education/Training

B.S. in Bioengineering, June 2007

University of Washington, Seattle, WA

Ph.D. in Materials Science and Engineering, August 2011

University of Washington, Seattle, WA

Postdoctoral Research Associate, August 2011 – January 2013

University of Washington, Seattle, WA

Department of Neurological Surgery, Department of Materials Science and Engineering

Positions and Honors

Positions

2005-2007 Undergraduate Research Assistant, Bioengineering Department, University of Washington, Seattle, WA

2007-2011 Graduate Research Assistant, Department of Materials Science and Engineering, University of Washington, Seattle, WA

2011-2013 Postdoctoral Research Associate, Department of Neurological Surgery, Materials Science and Engineering, University of Washington, Seattle, WA

2013-2016 Research Assistant Professor, Department of Neurological Surgery, University of Washington, Seattle, WA

2016-2016 Assistant Professor, Department of Neurological Surgery, University of Washington, Seattle, WA

2016-2016 Principle Investigator, Center for Integrative Brain Research, Seattle Children's Research Institute, Seattle, WA

2016-present Assistant Professor, Department of Biological Systems Engineering, University of Nebraska – Lincoln, Lincoln, NE

Awards

2006 NSF-UWEB Undergraduate Research Fellowship

2007 Mary Gates Endowment for Undergraduate Research

2008 NSF-UIF Graduate Research Fellowship

2010 NIH Ruth L. Kirschstein T32 Training Program in Nanotechnology and Physical Sciences in Cancer Research

2011 Egtvedt scholarship funding

2011 NIH Ruth L. Kirschstein T32 Training Program in Nanotechnology and Physical Sciences in Cancer Research

Professional Activities

2009-2010 Officer, Educational Outreach, University of Washington Nanotechnology and Nanoscience Student Association (NANSA)

2012-present Ad hoc reviewer, for journals:

- Biomaterials; Biomacromolecules; Nanomedicine; Small; Langmuir; Nanomedicine: Nanotechnology, Biology, and Medicine; Acta Biomaterialia; Molecules; Journal of Biomedical Nanotechnology; Advances in Colloid and Interface Science; BBA – General Subjects; Therapeutic Delivery; Journal of Environmental Management

2013-present American Brain Tumor Association Alumni Research Network member

Professional society memberships:

2013-present Society for Neuro-Oncology

2016-present American Institution of Chemical Engineers

Teaching Activities

Spring 2008 MSE170 TA – lab/quiz section

Summer 2013 UW Neurological Surgery Summer Student Research Program

Summer 2014 UW Neurological Surgery Summer Student Research Program

Winter 2015 MSE399 – Nanoparticles for gene delivery lecture

Summer 2015 UW Neurological Surgery Summer Student Research Program

Bibliography

Manuscripts in Refereed Journals

1. **F. M. Kievit**, O. Veiseh, N. Bhattarai, C. Fang, J. W. Gunn, D. Lee, R. G. Ellenbogen, J. M. Olson and M. Zhang. PEI-PEG-Chitosan Copolymer Coated Iron Oxide Nanoparticles for Safe Gene Delivery: synthesis, complexation, and transfection. *Adv Funct Mater* 19, 2244-2251, doi:10.1002/adfm.200801844 (2009).
2. O. Veiseh, J. W. Gunn, **F. M. Kievit**, C. Sun, C. Fang, J. S. Lee and M. Zhang. Inhibition of tumor-cell invasion with chlorotoxin-bound superparamagnetic nanoparticles. *Small* 5, 256-64, doi:10.1002/smll.200800646 (2009).
3. O. Veiseh, **F. M. Kievit**, J. W. Gunn, B. D. Ratner and M. Zhang. A ligand-mediated nanovector for targeted gene delivery and transfection in cancer cells. *Biomaterials* 30, 649-57, doi:10.1016/j.biomaterials.2008.10.003 (2009).
4. O. Veiseh, C. Sun, C. Fang, N. Bhattarai, J. Gunn, **F. Kievit**, K. Du, B. Pullar, D. Lee, R. G. Ellenbogen, J. Olson and M. Zhang. Specific targeting of brain tumors with an optical/magnetic resonance imaging nanoprobe across the blood-brain barrier. *Cancer Res* 69, 6200-7, doi:10.1158/0008-5472.CAN-09-1157 (2009).
5. C. Fang, O. Veiseh, **F. Kievit**, N. Bhattarai, F. Wang, Z. Stephen, C. Li, D. Lee, R. G. Ellenbogen and M. Zhang. Functionalization of iron oxide magnetic nanoparticles with targeting ligands: their physicochemical properties and in vivo behavior. *Nanomedicine (Lond)* 5, 1357-69, doi:10.2217/nnm.10.55 (2010).
6. **F. M. Kievit**, O. Veiseh, C. Fang, N. Bhattarai, D. Lee, R. G. Ellenbogen and M. Zhang. Chlorotoxin labeled magnetic nanovectors for targeted gene delivery to glioma. *ACS Nano* 4, 4587-94, doi:10.1021/nn1008512 (2010).
7. **F. M. Kievit**, S. J. Florczyk, M. C. Leung, O. Veiseh, J. O. Park, M. L. Disis and M. Zhang. Chitosan-alginate 3D scaffolds as a mimic of the glioma tumor microenvironment. *Biomaterials* 31, 5903-10, doi:10.1016/j.biomaterials.2010.03.062 (2010).
8. M. Leung, **F. M. Kievit**, S. J. Florczyk, O. Veiseh, J. Wu, J. O. Park and M. Zhang. Chitosan-alginate scaffold culture system for hepatocellular carcinoma increases malignancy and drug resistance. *Pharm Res* 27, 1939-48, doi:10.1007/s11095-010-0198-3 (2010).
9. H. Mok, O. Veiseh, C. Fang, **F. M. Kievit**, F. Y. Wang, J. O. Park and M. Zhang. pH-Sensitive siRNA nanovector for targeted gene silencing and cytotoxic effect in cancer cells. *Mol Pharm* 7, 1930-9, doi:10.1021/mp100221h (2010).
10. C. Sun, K. Du, C. Fang, N. Bhattarai, O. Veiseh, **F. Kievit**, Z. Stephen, D. Lee, R. G. Ellenbogen, B. Ratner and M. Zhang. PEG-mediated synthesis of highly dispersive multifunctional superparamagnetic nanoparticles: their physicochemical properties and function in vivo. *ACS Nano* 4, 2402-10, doi:10.1021/nn100190v (2010).
11. O. Veiseh, **F. M. Kievit**, C. Fang, N. Mu, S. Jana, M. C. Leung, H. Mok, R. G. Ellenbogen, J. O. Park and M. Zhang. Chlorotoxin bound magnetic nanovector tailored for cancer cell

- targeting, imaging, and siRNA delivery. *Biomaterials* 31, 8032-42, doi:10.1016/j.biomaterials.2010.07.016 (2010).
12. **F. M. Kievit** and M. Zhang. Surface engineering of iron oxide nanoparticles for targeted cancer therapy. *Acc Chem Res* 44, 853-62, doi:10.1021/ar2000277 (2011).
 13. **F. M. Kievit** and M. Zhang. Cancer Nanotheranostics: Improving Imaging and Therapy by Targeted Delivery across Biological Barriers. *Adv Mater* 23, H217-47, doi: 10.1002/adma.201102313 (2011). *cover highlight*
 14. O. Veiseh, **F. M. Kievit**, H. Mok, J. Ayes, C. Clark, C. Fang, M. Leung, H. Arami, J. O. Park and M. Zhang. Cell transcytosing poly-arginine coated magnetic nanovector for safe and effective siRNA delivery. *Biomaterials* 32, 5717-25, doi:10.1016/j.biomaterials.2011.04.039 (2011).
 15. J. O. Park, Z. Stephen, C. Sun, O. Veiseh, **F. M. Kievit**, C. Fang, M. Leung, H. Mok and M. Zhang. Glypican-3 targeting of liver cancer cells using multifunctional nanoparticles. *Mol Imaging* 10, 69-77 (2011).
 16. A. Cooper, N. Bhattarai, **F. M. Kievit**, M. Rossol and M. Zhang. Electrospinning of chitosan derivative nanofibers with structural stability in an aqueous environment. *Phys Chem Chem Phys* 13, 9969-72, doi:10.1039/c0cp02909b (2011).
 17. **F. M. Kievit**, F. Y. Wang, C. Fang, H. Mok, K. Wang, J. R. Silber, R. G. Ellenbogen and M. Zhang. Doxorubicin loaded iron oxide nanoparticles overcome multidrug resistance in cancer in vitro. *J Control Release* 152, 76-83, doi:10.1016/j.jconrel.2011.01.024 (2011).
 18. O. Veiseh, **F. M. Kievit**, R. G. Ellenbogen and M. Zhang. Cancer cell invasion: treatment and monitoring opportunities in nanomedicine. *Adv Drug Deliv Rev* 63, 582-96, doi:10.1016/j.addr.2011.01.010 (2011).
 19. Stephen ZR, **Kievit FM**, Zhang M. Magnetite nanoparticles for medical MR imaging. *Materials Today* 14, 330-8 doi:0.1016/S1369-7021(11)70163-8 (2011).
 20. **F. M. Kievit**, Z. R. Stephen, O. Veiseh, H. Arami, T. Wang, V. P. Lai, J. O. Park, R. G. Ellenbogen, M. L. Disis and M. Zhang. Targeting of primary breast cancers and metastases in a transgenic mouse model using rationally designed multifunctional SPIONs. *ACS Nano* 6, 2591-601, doi:10.1021/nn205070h (2012).
 21. S. J. Florczyk, G. Liu, **F. M. Kievit**, A. M. Lewis, J. D. Wu, M. Zhang. 3D porous chitosan-alginate scaffolds: New matrix for studying prostate cancer cell-lymphocyte interaction in vitro. *Advanced Healthcare Materials* 1, 590-9, doi:10.1002/adhm.201100054 (2012).
 22. C. Fang, **F. M. Kievit**, Y. C. Cho, H. Mok, O. W. Press and M. Zhang. Effect of cationic side-chains on intracellular delivery and cytotoxicity of pH sensitive polymer-doxorubicin nanocarriers. *Nanoscale* 4, 7012-20, doi:10.1039/c2nr32159a (2012).
 23. C. Fang, **F. M. Kievit**, O. Veiseh, Z. R. Stephen, T. Wang, D. Lee, R. G. Ellenbogen and M. Zhang. Fabrication of magnetic nanoparticles with controllable drug loading and release through a simple assembly approach. *J Control Release* 162, 233-41, doi:10.1016/j.jconrel.2012.06.028 (2012).
 24. V. Pan-Lai, S. J. Florczyk, **F. M. Kievit**, K. Wang, E. Gad, N. L. Disis, M. Zhang. Three-Dimensional Scaffolds to Evaluate Tumor Associated Fibroblast-Mediated Suppression of Breast Tumor Specific T Cells. *Biomacromolecules* 14, 1330-7, doi: 10.1021/bm301928u (2013).
 25. T. Wang, **F. M. Kievit**, O. Veiseh, H. Arami, Z. R. Stephen, C. Fang, Y. Liu, R. G. Ellenbogen, M. Zhang. Targeted cell uptake of a non-internalizing antibody through conjugation to iron oxide nanoparticles in primary central nervous system lymphoma. *World Neurosurgery* 80, 134-41, doi: 10.1016/j.wneu.2013.01.011 (2013).
 26. O. Veiseh, **F. M. Kievit**, V. Liu, C. Fang, Z. R. Stephen, R. G. Ellenbogen, M. Zhang. In vivo safety evaluation of polyarginine coated magnetic nanovectors. *Molecular Pharmaceutics* 10, 4099-106, doi: 10.1021/mp4005468 (2013).

27. S. J. Florczyk, K. Wang, S. Jana, D. L. Wood, S. K. Sytsma, J. G. Sham, **F. M. Kievit**, M. Zhang. Porous chitosan-hyaluronic acid scaffolds as a mimic of glioblastoma microenvironment ECM. *Biomaterials* 34, 10143-50, doi: 10.1016/j.biomaterials.2013.09.034 (2013).
28. **F. M. Kievit**, A. Cooper, S. Jana, M. C. Leung, K. Wang, D. Edmondson, D. Wood, J. S. H. Lee, R. G. Ellenbogen, M. Zhang. Aligned Chitosan-Polycaprolactone Polyblend Nanofibers Promote the Migration of Glioblastoma Cells. *Advanced Healthcare Materials* 2, 1651-9, doi: 10.1002/adhm.201300092 (2013).
29. V. Phan-Lai, **F. M. Kievit**, S. J. Florczyk, K. Wang, M. L. Disis, M. Zhang. CCL21 and IFN γ Recruit and Activate Tumor Specific T cells in 3D Scaffold Model of Breast Cancer. *Anti-cancer Agents in Medicinal Chemistry* 14, 204-10, doi: 10.2174/18715206113136660375 (2014).
30. J. G. Sham, **F. M. Kievit**, J. R. Grierson, R. S. Miyaoka, M. M. Yeh, M. Zhang, R. S. Yeung, S. Minoshima, J. O. Park. Glypican-3 Targeted ^{89}Zr -PET Imaging of Hepatocellular Carcinoma. *Journal of Nuclear Medicine* 55, 799-804 doi: 10.2967/jnumed.113.132118 (2014).
31. C. T. Tsao, **F. M. Kievit**, K. Wang, A. E. Erickson, R. G. Ellenbogen, M. Zhang. Chitosan-Based Thermoreversible Hydrogel as an in Vitro Tumor Microenvironment for Testing Breast Cancer Therapies. *Molecular Pharmaceutics* 11, 2134–42 doi: 10.1021/mp5002119 (2014).
32. C. T. Tsao, **F. M. Kievit**, A. Ravanpay, A. E. Erickson, M. C. Jensen, R. G. Ellenbogen, M. Zhang. Thermoreversible Poly(ethylene glycol)-g-Chitosan Hydrogel as a Therapeutic T Lymphocyte Depot for Localized Glioblastoma Immunotherapy. *Biomacromolecules* 15, 2656–62 doi: 10.1021/bm500502n (2014).
33. **F. M. Kievit**, S. J. Florczyk, M. C. Leung, K. Wang, J. D. Wu, J. R. Silber, R. G. Ellenbogen, J. S. H. Lee, M. Zhang. Proliferation and enrichment of CD133+ glioblastoma cancer stem cells on 3D chitosan-alginate scaffolds. *Biomaterials* 35, 9137-43 doi:10.1016/j.biomaterials.2014.07.037 (2014).
34. Z. R. Stephen, **F. M. Kievit**, O. Veisoh, P. A. Chiarelli, C. Fang, K. Wang, S. J. Hatzinger, R. G. Ellenbogen, J. R. Silber, M. Zhang. Redox-Responsive Magnetic Nanoparticle for Targeted Convection-Enhanced Delivery of O⁶-Benzylguanine to Brain Tumors. *ACS Nano* 8, 10383-95 doi: 10.1021/nn503735w (2014).
35. J. G. Sham, **F. M. Kievit**, J. R. Grierson, P. A. Chiarelli, R. S. Miyaoka, M. Zhang, R. S. Yeung, S. Minoshima, J. O. Park. Glypican-3 Targeting F(ab')₂ for ^{89}Zr -PET of Hepatocellular Carcinoma. *Journal of Nuclear Medicine* 55, 2032-7 doi:10.2967/jnumed.114.145102 (2014).
36. P. A. Chiarelli, **F. M. Kievit**, M. Zhang, R. G. Ellenbogen. Bionanotechnology and the future of glioma. *Surgical Neurology International* 6, Suppl S1:45-58 doi:10.4103/2152-7806.151334 (2015).
37. C. Fang, K. Wang, Z. R. Stephen, Q. Mu, **F. M. Kievit**, D. T. Chiu, O. W. Press, M. Zhang. Temozolomide Nanoparticles for Targeted Glioblastoma Therapy. *ACS Applied Materials & Interfaces* 7, 6674-82 doi:10.1021/am5092165 (2015).
38. **F. M. Kievit**, Z. R. Stephen, K. Wang, C. J. Dayringer, J. G. Sham, J. R. Silber, R. G. Ellenbogen, M. Zhang. Nanoparticle mediated silencing of DNA repair sensitizes pediatric brain tumor cells to γ -irradiation. *Molecular Oncology* 9, 1071-80 doi:10.1016/j.molonc.2015.01.006 (2015).
39. K. Wang, **F. M. Kievit**, S. J. Florczyk, Z. R. Stephen, M. Zhang. 3D Porous Chitosan–Alginate Scaffolds as an In Vitro Model for Evaluating Nanoparticle–Mediated Tumor Targeting and Gene Delivery to Prostate Cancer. *Biomacromolecules* 16, 3362-72. doi:10.1021/acs.biomac.5b01032 (2015).

40. Q. Mu, **F. M. Kievit**, R. J. Kant, G. Lin, M. Jeon, M. Zhang. Anti-HER2/neu peptide-conjugated iron oxide nanoparticles for targeted delivery of paclitaxel to breast cancer cells. *Nanoscale* 7, 6674-82. doi:10.1039/C5NR04867B (2015).
41. K. Wang, **F. M. Kievit**, M. Jeon, J. R. Silber, R. G. Ellenbogen, M. Zhang. Nanoparticle-mediated target delivery of TRAIL as gene therapy for glioblastoma. *Adv Healthcare Mater* 4, 2719-26. doi: 10.1002/adhm.201500563 (2015).
42. K. Wang, **F. M. Kievit**, J. G. Sham, M. Jeon, Z. R. Stephen, A. Bakthavatsalam, J. O. Park, M. Zhang. Iron oxide-based nanovector for tumor targeted siRNA delivery in an orthotopic hepatocellular carcinoma xenograft mouse model. *Small* 12, 477-87. doi: 10.1002/smll.201501985 (2016).
43. **F. M. Kievit**, K. Wang, A. E. Erickson, S. K. Lan Levengood, R. G. Ellenbogen, M. Zhang. Modeling the tumor microenvironment using chitosan-alginate scaffolds to control the stem-like state of glioblastoma cells. *Biomaterials Science*. 4, 610-3. doi: 10.1039/C5BM00514K (2016).
44. J. Xu, M. Ypma, P. A. Chiarelli, J. Park, R. G. Ellenbogen, P. S. Stayton, P. D. Mourad, D. Lee, A. J. Convertine, **F. M. Kievit**. Theranostic Oxygen Reactive Polymers for Treatment of Traumatic Brain Injury. *Adv Funct Mater*. 26, 4124-33. doi: 10.1002/adfm.201504416 (2016).

Book Chapters

1. Phan-Lai, V., Cecil, D., Holt, G., Herendeen, D., **Kievit, F.**, Zhang, M. and Disis, M.L. Epitope-based vaccines for cancer. In: *Cancer Vaccines*, 2nd ed., Bot, A., Obrocea, M., and Marincola, F., editors. New York: Informa Healthcare, 2011, 140-149.

Patents

1. **Forrest Kievit**, Anthony Convertine, Richard Ellenbogen, Patrick Stayton, Pierre Mourad. 2015. Theranostic nanoparticles for treatment of traumatic brain injury. US Patent application 62/237,915 filed 10/6/2015.
2. Miqin Zhang, Richard Ellenbogen, **Forrest Kievit**, John Silber, Zachary Stephen, Omid Veisheh. 2014. Nanoparticle for targeting brain tumors and delivery of O6-benzylguanine. US Patent application 14/222443 filed 3/21/2014.
3. Miqin Zhang, Omid Veisheh, Chen Fang, **Forrest Kievit**. 2013. Polyarginine-coated magnetic nanovector and methods of use thereof. US Patent application 13/893,137 filed 5/13/2013.
4. Miqin Zhang, **Forrest Kievit**, Stephen Florczyk. 2012. Rapid enrichment of the cancer stem cell population using chitosan-alginate scaffolds. US Patent application 61/621,683 filed April 9, 2012.
5. Miqin Zhang, **Forrest Kievit**, Matthew Leung, Stephen Florczyk. Chitosan-alginate scaffold cell culture system and related methods. US Patent US9157908 B2.

Presentations

1. **Forrest Kievit**, Omid Veisheh, Conroy Sun, Narayan Bhattarai, Kim Du, Miqin Zhang. *University of Washington Undergraduate Students in Research Program Poster Presentations*, Seattle, WA (June 2006).
2. **Forrest Kievit**, Omid Veisheh, Joel Pritchard, Jim Olson, Miqin Zhang. *University of Washington Undergraduate Students in Research Program Final Presentations*, Seattle, WA (February 2007).
3. **Forrest Kievit**, Omid Veisheh, Joel Pritchard, Jim Olson, Miqin Zhang. *University of Washington Undergraduate Research Symposium*, Seattle, WA (May 2007).

4. **Forrest Kievit**, Omid Veiseh, Joel Pritchard, Jim Olson, Miqin Zhang. University of Washington Undergraduate Bioengineering Department Poster Presentations, Seattle, WA (June 2007).
5. **Forrest Kievit**, Omid Veiseh, Jim Park, Miqin Zhang. Autumn 2008 Center for Nanotechnology Student Symposium, Seattle, WA (December 2008).
6. **Forrest Kievit**, Omid Veiseh, Narayan Bhattarai, Jonathan Gunn, Chen Fang, Miqin Zhang. 238th American Chemical Society National Meeting, Washington, DC (August 2009).
7. **Forrest Kievit**, Richard Ellenbogen, Miqin Zhang. Annual Meeting for the T32 Nanotechnology/Cancer Training Program, Seattle, WA (September 2010).
8. **Forrest Kievit**. Materials Science and Engineering Department Seminar, Seattle, WA (November 2012).
9. **Forrest Kievit**, Richard Ellenbogen, Miqin Zhang. Annual Meeting for the T32 Nanotechnology/Cancer Training Program, Seattle, WA (December 2012).
10. **Forrest Kievit**, Zachary Stephen, Kui Wang, John Silber, Richard Ellenbogen, Miqin Zhang. Society for Neuro-Oncology 2013 Pediatric Neuro-Oncology Basic and Translational Research Conference. Fort Lauderdale, FL (May 2013).
11. **Forrest Kievit**, Zachary Stephen, Kui Wang, Douglas Kolstoe, John Silber, Richard Ellenbogen, Miqin Zhang. 2013 World Federation of Neuro-Oncology Meeting. San Francisco, CA (November 2013).
12. **Forrest Kievit**, Zachary Stephen, Kui Wang, Christopher Dayringer, John Silber, Richard Ellenbogen, Miqin Zhang. 2014 American Brain Tumor Association Alumni Research Network Meeting. Chicago, IL (September 2014).
13. **Forrest Kievit**, Zachary Stephen, Kui Wang, Christopher Dayringer, John Silber, Richard Ellenbogen, Miqin Zhang. 2014 World Federation of Neuro-Oncology Meeting. Miami, FL (November 2014).
14. **Forrest Kievit**, Zachary Stephen, Kui Wang, Christopher Dayringer, John Silber, Richard Ellenbogen, Miqin Zhang. 2015 ABTA Patient and Family Conference. Chicago, IL (July 2015).
15. **Forrest Kievit**. Pathology Department Seminar, Seattle, WA (November 2015).
16. **Forrest Kievit**. Vanderbilt Department of Pharmacology Seminar Series, Nashville, TN (December 2015).

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The goal of this study was to test how knockdown of Ape1 activity in pediatric brain tumor cells using nanoparticles enhances their sensitivity to radiation therapy.