Charles 'Wyatt' Shields IV

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PROFESSIONAL POSITIONS

2020 **Assistant Professor**, Department of Chemical and Biological Engineering
University of Colorado, Boulder
Start date: January 1, 2020

EDUCATION AND TRAINING

2018-Present **Harvard University**, Cambridge, MA
Postdoctoral Fellow, Bioengineering
Advisor: Prof. Samir Mitragotri

2016-2017 **North Carolina State University,** Raleigh, NC
Postdoctoral Associate, Chemical and Biological Engineering
Advisors: Prof. Orlin D. Velev & Prof. Stefan Zauscher

2016 **Duke University**, Durham, NC
Ph.D., Biomedical Engineering
Dissertation: Acoustic and magnetic isolation and analysis of cells in microfluidic platforms
Advisor: Prof. Gabriel P. López

2011 **University of Virginia**, Charlottesville, VA
B.S. with High Distinction, Biomedical Engineering
Advisors: Prof. Jeffrey J. Saucerman & Prof. William F. Walker

AWARDS AND HONORS

2016 Dean's Award for Excellence in Mentoring, Duke University
2015 Exceptional Student Award, ISAC (international award to 1 Ph.D. student annually)
2014 NSF Graduate Research Opportunities Worldwide Award (to study in Lund, Sweden)
2013 Exceptional Student Award**,** ISAC (international award to 1 Ph.D. student annually)
2012 NSF Graduate Research Fellowship
2011 NSF Research Triangle MRSEC Fellowship
2011 Undergraduate Research & Design Symposium Finalist
2011 The Raven Society, UVA
2010 Tau Beta Pi Engineering Honor Society

RESEARCH INTERESTS

Colloid and interface science, self-assembly, directed assembly, active particles, soft matter, drug delivery, microfluidics, immunotherapy, cancer therapy, nanomaterials, functional materials, polymer science, biosensors, *in vitro* diagnostics, stimuli responsive materials, directed cell manipulations, acoustofluidics

PUBLICATIONS

24. Ohiri, U; Shields IV, CW; Han, K; Tyler, T; Velev, OD; Jokerst, N. "Engineered reconfigurable motile semiconductor microparticles," *Nature Communications* **2018**. 9(*1*): 1791. DOI: 10.1038/s41467-018-04183-y.
23. Shields IV, CW; Han, K; Ma, F; Miloh, T; Yossifon, G; Velev, OD. "Supercolloidal spinners: Complex active particles for electrically powered and switchable rotation," *Advanced Functional Materials* **2018**. 28(*35*): 1803465. DOI: 10.1002/adfm.201803465.
22. Reyes, C; Fu, L; Suthanthiraraj, PPA; Owens, CE; Shields IV, CW; López, GP; Charbonneau, P; Wiley, B. "The limits of primary radiation force in bulk acoustic standing waves for concentrating nanoparticles," *Particle & Particle Systems Characterization* **2018**. 35(*7*): 1700470. DOI: 10.1002/ppsc.201700470.
21. Shields IV, CW;* White, JP; Osta, EG; Patel, J; Rajkumar, S; Kirby, N; Therrien, JP; Zauscher, S.* "Encapsulation and controlled release of retinol from silicone particles for topical delivery," *Journal of Controlled Release* **2018**. 278: 37-48. DOI: 10.1016/j.jconrel.2018.03.023. (*Corresponding authors)
20. Han, K; Shields IV, CW; Velev, OD. "Engineering of self-propelling microbots and microdevices powered by magnetic and electric fields," *Advanced Functional Materials* **2018**. 28(*25*): 1705953. DOI: 10.1002/adfm.201705953.
19. Shields IV, CW; Velev, OD. "The evolution of active particles: Towards externally powered self-propelling and self-reconfiguring particle systems," *Chem* **2017**. 3(*4*): 539-559. DOI: 10.1016/j.chempr.2017.09.006.
18. Han, K; Shields IV, CW; Diwakar, NM; Bharti, B; López, GP; Velev, OD. "Sequence-encoded colloidal origami and microbot assemblies from patchy magnetic cubes," *Science Advances* **2017**. 3(*8*). e1701108. DOI: 10.1126/sciadv.1701108.
17. Fu, L; Bian, C; Shields IV, CW; Cruz, D; López, GP; Charbonneau, P. "Assembly of hard spheres in a cylinder: a computational and experimental study," *Soft Matter* **2017**. 13(*18*): 3296-3306. DOI: 10.1039/C7SM00316A.
16. Shields IV, CW; Ohiri, KA; Szott, LM; López, GP. "Translating microfluidics: Cell separation technologies and their barriers to commercialization," *Cytometry Part B* **2017**. 92(*2*): 115-125. DOI: 10.1002/cyto.b.21388.
15. Ohiri, KA; Evans, BA; Shields IV, CW; Gutiérrez, RA; Carroll, NJ; Yellen, BB; López, GP. "Negative acoustic contrast microparticles with high magnetic susceptibilities for bioanalytical applications," *ACS Applied Materials and Interfaces* **2016**. 8(*23*): 25030–25035. DOI: 10.1021/acsami.6b09591.
14. Shields IV, CW; Wang, JL; Ohiri, KA; Essoyan, ED; Yellen, BB; Armstrong, AJ; López, GP. "Microfluidic device for separating cancer cells from whole blood: acoustically enhanced magnetic sorting and single cell templating," *Lab on a Chip* **2016**. 16(*19*): 3833-3844. DOI: 10.1039/c6lc00719h.
13. Johnson, KA; Vormohr, HR; Doinikov, AA; Bouakaz, A; Shields IV, CW; López, GP; Dayton, PA. "Experimental verification of theoretical equations for acoustic radiation force on compressible spherical particles in traveling waves," *Physical Review E* **2016**. 93*(5)*: 053109. DOI: 10.1103/PhysRevE.93.053109.
12. Shields IV, CW; Cruz, DF; Ohiri, KA; Yellen, BB; López, GP. "Fabrication and operation of acoustofluidic devices supporting bulk acoustic standing waves for sheathless focusing of particles," *Journal of Visualized Experiments* **2016**. *(109)*: e53861. DOI: 10.3791/53861.
11. Wang, PY;* Shields IV, CW;* Zhao, T; Jami, H; López, GP; Kingshott, P. "Rapid self-assembly of shaped microtiles into large, close-packed crystalline monolayers on a solid surface," *Small* **2016**. 12*(2)*: 1309-1314. DOI: 10.1002/smll.201503130. (*co-first author)
10. Owens, CE; Shields IV, CW; Cruz, DF; Charbonneau, P; López, GP. "Highly parallel acoustic assembly of microparticles into well-ordered colloidal crystallites," *Soft Matter* **2016**. 12*(3)*: 717-728. DOI: 10.1039/C5SM02348C.
9. Shields IV, CW; Reyes, C.; López, GP. "Microfluidic cell sorting: A review of the advances in the separation of cells from debulking to rare cell isolation," *Lab on a Chip* **2015**. 15*(5)*: 1230-1249. DOI: 10.1039/C4LC01246A.
8. Gao, L; Shields IV, CW; Johnson, LM; Graves, SW; Yellen, BB; López, GP. "Two-dimensional spatial manipulation of microparticles in continuous flows in acoustofluidic chips," *Biomicrofluidics* **2015**. 9*(1)*: 014105. DOI: 10.1063/1.4905875.

7. Shields IV, CW; Livingston, CE; Yellen, BB; López, GP; Murdoch, DM. "Magnetographic array for the capture and enumeration of single cells and cell pairs," *Biomicrofluidics* **2014**. 8*(4)*: 041101. DOI: 10.1063/1.4885840. PMCID: PMC4188346.
6. Shields IV, CW; Sun, D; Johnson, K; Duval, K; Rodriguez, AV; Gao, L; Dayton, PA; López, GP. "Nucleation and growth synthesis of functional, monodisperse and acoustically programmable particles," *Angewandte Chemie International Edition* **2014**. 53*(31)*: 8070-8073. DOI: 10.1002/anie.201402471.
5. Shields IV, CW; Johnson, LM; Gao, L; López, GP. "Elastomeric negative acoustic contrast particles for capture, acoustophoretic transport, and confinement of cells in microfluidic systems," *Langmuir* **2014**. 30*(14)*: 3923-3927. DOI: 10.1021/la404677w.
4. Yang, JH; Polanowska-Grabowska, RK; Smith, JS; Shields IV, CW; Saucerman, JJ. "PKA catalytic subunit compartmentation regulates contractile and hypertropic responses to β-adrenergic signaling," *Journal of Molecular and Cellular Cardiology* **2014**. 66 *(0)*: 83-93. DOI: 10.1016/j.yjmcc.2013.11.001.
3. Liu, J; Shields IV, CW; Omofoye, O; López, GP. "Programmable anisotropic microparticles for self-assembly applications," *Materials Research Society Symposium Proceedings* **2014**. 1622: 1-6. DOI: 10.1557/opl.2014.38.
2. Shields IV, CW; Zhu, S; Yang, Y; Bharti, B; Liu, J; Yellen, BB; Velev, OD; López, GP. "Field-directed assembly of patchy anisotropic microparticles with defined shape," *Soft Matter* **2013**. 9*(38)*: 9219-9229. DOI: 10.1039/C3SM51119G.
1. Johnson, LM; Gao, L; Shields IV, CW; Smith, M; Efimenko, K; Cushing, K; Genzer, J; López, GP. "Elastomeric microparticles for acoustic mediated bioseparations," *Journal of Nanobiotechnology* **2013**. 11*(22)*: 1-19. DOI: 10.1186/1477-3155-11-22.

INTELLECTUAL PROPERTY

2. Shields IV, CW; Kirby, N; López, GP. "Compositions, systems, and methods for the encapsulation and delivery of a substance," U.S. Patent App. No.: 15/492,786. Filed April 20, 2017. ***Licensed to Encapsio, LLC June 2017.**
1. Johnson, LM; López, GP; Shields IV, CW; Gao, L. "Acoustically responsive particles," U.S. Patent 9,797,897. Granted October 24, 2017.

PODIUM PRESENTATIONS

Invited talks

5. Elastomeric particles for cell and biomarker isolation in acoustofluidic devices. 256th ACS National Meeting (Boston, MA). August 2018. Shields IV, CW; Ohiri, KA; Johnson, LM; Li, AL; López, GP.
4. Supracolloidal particles for cell separation, drug delivery and the programmed assembly of soft active materials. University of Colorado Boulder, Department of Chemical and Biological Engineering (Boulder, CO). February 2018. Shields IV, CW.
3. Rational design of supracolloidal particles for active soft matter and biomedicine. Colorado School of Mines, Department of Chemical and Biological Engineering (Golden, CO). February 2018. Shields IV, CW.
2. Sonocrystallization: Application of radiation forces from acoustic standing waves for configurable assembly. APS March Meeting (New Orleans, LA). March 2017. Shields IV, CW.
1. Microfluidic cell sorting: Acoustic and magnetic methods for cell separation and analysis. IBM Thomas J. Watson Research Center (White Plains, NY). November 2015. Shields IV, CW.

Contributed talks

21. Encapsulation, protection and programmed release of retinol from silicone particles for topical applications. 256th ACS National Meeting (Boston, MA). August 2018. Shields IV, CW; White, JP; Osta, EG; Patel, J; Rajkumar, S; Zauscher, S.
20. Moving past simple shapes: Engineered active particle spinners and motors powered by AC electric fields. 2017 AIChE Annual Meeting (Minneapolis, MN). October 2017. Shields IV, CW; Han, K; Ma, F; Velev, OD.

19. Rational design of active particles for programmed spinning and precession by AC electric fields. 2017 MRS International Materials Research Congress (Cancun, Mexico). August 2017. Shields IV, CW; Han, K; Ma, F; Velev, OD.
18. A self-assembled microviscometer: Reconfigurable microdevices from patchy microcubes for investigating liquid crystals. 2017 MRS International Materials Research Congress (Cancun, Mexico). August 2017. Shields IV, CW; Han, K; Murphy, AC; Scott, A; Kim, YG; López, GP; Abbott, NL; Velev, OD.
17. Encapsulation and controlled release of active ingredients from monodisperse, silicone particles. 2016 MRS Fall Meeting & Exhibit iMatSci (Boston, MA). November 2016. Shields IV, CW.
16. Acoustic and magnetic methods for the isolation and analysis of biomarkers in microfluidic platforms. Acoustofluidics (Tech. Univ. of Denmark, Copenhagen). September 2016. Shields IV, CW; López, GP.
15. Promise of elastomeric particles: Bio- sequestration, separation and delivery. 90th Colloid & Surface Science Symposium (Harvard Univ., Boston, MA). June 2016. Shields IV, CW; Ohiri, KA; Li, L; Huang, J; White, J; Zhang, Y; Zauscher, S, Chilkoti, A; López, GP.
14. Configurable assembly of microparticles via acoustic standing waves. 90th Colloid & Surface Science Symposium (Harvard Univ., Boston, MA). June 2016. Shields IV, CW; Owens, CE; Reyes, C; Suthanthiraraj, PPA; Fu, L; Wiley, BJ; Charbonneau, P; López, GP.
13. Acoustic radiation forces for the rapid and programmable assembly of microparticles and nanoparticles. 251st ACS National Meeting (San Diego, CA). March 2016. Shields IV, CW; Owens, CE; Suthanthiraraj, PPA; Reyes, C; Cruz, DF; Fu, L; Wiley, BJ; Charbonneau, P; López, GP.
12. Peptide-conjugated elastomeric particles for acoustic isolation of biomarkers from whole blood. 251st ACS National Meeting (San Diego, CA). March 2016. Shields IV, CW; Li, L; Huang, J; Zhang, A; Ohiri, KA; Chilkoti, A; López, GP.
11. Magnetic separation of acoustically focused cancer cells from blood for magnetographic templating and cellular analysis. 251st ACS National Meeting (San Diego, CA). March 2016. Shields IV, CW; Wang, J; Ohiri, KA; Essoyan, ED; Yellen, BB; Armstrong, AJ; López, GP.
10. Acoustic and magnetic methods for cell sorting and single cell analysis in a microfluidic device. 30th CYTO Meeting (Glasgow, Scotland). June 2015. Shields IV, CW; Wang, J; Ohiri, KA; Prashanth, P; López, GP.
9. Functional, monodisperse and acoustically programmable silicone gel particles for bioanalytical acousto-fluidics. 88th Colloid & Surface Science Symposium (Univ. of Pennsylvania, Philadelphia, PA). June 2014. Shields IV, CW; Duval, K; Sun, D; López, GP.
8. Acoustically programmable, elastomeric particles. 2014 MRS Fall Meeting & Exhibit iMatSci (Boston, MA). November 2014. Shields IV, CW; Johnson, LM; Gao, L; López, GP.
7. Directed assembly of microactuators: Field-controlled folding and bending of chains of patchy microcubes. 88th Colloid & Surface Science Symposium (Univ. of Pennsylvania, Philadelphia, PA). June 2014. Shields IV, CW; Han, K; Bharti, B; Velev, OD; López, GP.
6. Microfluidic systems for acoustic cell sorting. Prostate Cancer Research Forum at Duke Hospital (Durham, NC). May 2014. Shields IV, CW; Duval, K; Sun; D; López, GP.
5. Elastomeric particles for acoustophoretic bioseparations. Duke University Pratt Frontiers in Technology Translation (Durham, NC). May 2014. Shields IV, CW; Johnson, LM; Gao, L; López, GP.
4. Programmable microparticles synthesized from nucleation and growth for on-chip biosensing. 2nd IZON Science Symposium (Boston Univ., Boson, MA). October 2013. Shields IV, CW; Sun, D; Gao, L; Johnson, K; Dayton, PA; López, GP.
3. Anisotropic-shaped microparticles for self-assembly applications. 5th Self-Assembled Soft Matter Nano-Structures at Interfaces Meeting (New Bern, NC). September 2013. Shields IV, CW; Bharti, B; Velev, OD; López, GP.
2. Acoustofluidic cell sorting via negative acoustic contrast capture colloids. 28th CYTO Meeting (San Diego, CA). May 2013. Shields IV, CW; Johnson, LM; Gao, L; López, GP.
1. Controlling cell decisions by manipulating subcellular signaling. Undergraduate Research and Design Symposium (U. of Virginia, Charlottesville). May 2011. Smith SJ & Shields IV, CW; Yang, JH; & Saucerman, JJ.

PRESS FEATURES

2018 *Nature Communications* article: Phys.org, EurekAlert!, Science Daily, Science NewsLine, Science Magazine, NanoWerk, ECN, Long Room, Techristic, Pratt, etc.
2017 Startup (Encapsio, LLC) recognized by Duke University: Pratt Article
2017 *Science Advances* article: C&E, Phys.org, EurekAlert!, Science Daily, TechCrunch, ZDNet, NanoWerk, Newsy, WIRED, The Engineer, Chemistry World, NSF, etc.
2017 Startup (Encapsio, LLC) provides Q&A with the founders: DukEngineer
2016 Startup (Encapsio, LLC) wins the Big Launch Challenge: Big Launch, ExitEvent, WRAL
2016 Startup (Encapsio, LLC, formerly microSiO) wins the NC IDEA: NC IDEA, ExitEvent, WRAL
2016 Duke University Dean's Award for Excellence in Mentoring: Link to recipient profile
2015 *Cytometry A*; Vol. 85A, No. 12: Exceptional Student Award; DOI: 10.1002/cyto.a.22786
2015 *Lab on a Chip* article: CytoFluidix
2014 NSF Science360 Highlight on *Angewandte Chemie* article: Science360
2013 *Cytometry A*; Vol. 83A, No. 7: Exceptional Student Award; DOI: 10.1002/cyto.a.22328

ACADEMIC SERVICE AND OUTREACH

2018 Presider for "Engineering the Interface" Session in the Biomaterials & Biointerfaces Symposium at the 256th ACS National Meeting
2016- Reviewer for *ACS Nano, Analytica Chimica Acta, Bioengineering & Translational Medicine, Biointerphases, IEEE Transactions on Electron Devices, Journal of Materials Chemistry C, Lab on a Chip, Scientific Reports* (*Nature), Sensors*, etc. (verified by Publons)
2014- Presenter at outreach events (prepared and presented interactive demos on acoustic forces, nanomaterials, thermal conductivity, etc.): *NISE Network NanoDays, Science Under the Stars, NC Science Festival, Riverside High School Lecture Series*, etc.