(Edmond) Tingtao Zhou

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Education

Massachusetts Institute of Technology Cambridge, MA, USA
Ph. D. in Physics 2019
Thesis Title: Phase Transitions Induced Deformation in Porous Media.
Advisor: Marin Z. Bazant

Peking University Beijing, China
B. Sc. in Physics 2012
Advisor: Douglas N.C. Lin

Research Interests

My current research focuses on the fundamentals and applications of soft and living matter. Using theory/computation, machine learning and experiments, I work at the intersection of fluid mechanics and active matter, and non-equilibrium statistical physics in general, emphasizing materials, environmental, medical and energy applications.

Employment

California Institute of Technology **Division of Chemistry and Chemical Engineering**
Postdoctoral Scholar 2022.03-now

California Institute of Technology **Division of Engineering and Applied Science**
Cecil and Sally Drinkward Postdoctoral Fellow 2020.03-2022.03
Advisors: John F. Brady, Chiara Daraio

Patents

Anti-infection fluidic channel, **T. Zhou**, *X. Wan, J.F. Brady, P.W. Sternberg and C. Daraio et al.*

1. Patent No.: US 12,220,539 , Date of Patent: Oct. 29, 2024.
2. Patent No.: US 12,220,539 2, Date of Patent: Feb. 11, 2025
3. Patent Application: Pub. No.: US 2025/0128021 A1, Pub. Date: Apr. 24, 2025
4. CIT#8977-CN, China (Pending)
5. CIT#8977-EPO, Europe (Pending)
6. CIT#8977-IN, India (Pending)

Publications (* for equal contribution, † for (co-)correspondence)

Under Review:

4. Hydrodynamic interactions destroy bulk motility-induced phase separation.
T. Zhou *and J.F.Brady*
3. Revisiting some low Reynolds number resistance functions.
T. Zhou *and J.F.Brady*
2. Decoding Optimal Mate-searching in C. elegans.
X. Wan, **T. Zhou****, V. Susoy***, C. Park, A. Groaz, S. Aravi, J.F.Brady, and P.W.Sternberg.*
1. Reviving the suspension balance model.
M. Wang, **T. Zhou**† *and J.F.Brady*†

Published:

24. Active doping controls the mode of failure in dense colloidal gels, PNAS (direct submission, **2024**)
T. Zhou *and J.F.Brady*

23. AI-aided geometric design of anti-infection catheters, Science Advances (**2024**).
T. Zhou*, *X. Wan**, *Z. Huang, Z. Li, Z. Peng, A. Anandkumar, J.F. Brady, P.W. Sternberg and C. Daraio*
Caltech News: New Catheter Design Prevents Bacterial Infections.

22. Image charge effects in electrolyte solutions under dielectric and metal boundary conditions.
Physical Review E (**2024**)
T. Zhou, *D. Bruch, Z.-G. Wang*

21. Turbulent transport of dusts in proto-planetary disks: the effect of upstream diffusion, Astrophysical Journal (**2022**).
T. Zhou, *H. Deng, Y. Chen and D. N.C. Lin*

20. Distribution and pressure of active Lévy swimmers under confinement, Journal of Physics A: Mathematical and Theoretical (**2021**)
T. Zhou, *Z. Peng, M. Gulian, J.F. Brady*

19. Theory of freezing point depression in charged porous media, Physical Review E (**2021**).
T. Zhou, *M. Mirzadeh, R. Pellenq and M.Z. Bazant.*

18. Freezing Point Depression and Material Damage by Nano-fluidic Salt Trapping, Physical Review Fluids (**2020**).
T. Zhou, *M. Mirzadeh, R. Pellenq and M.Z. Bazant.*

17. Multiscale Poromechanics of Wet Cement Paste.
T. Zhou, *K. Ioannidou, F. Ulm, M.Z. Bazant and R. Pellenq*, PNAS (direct submission, **2019**).
(Student paper award in the Engineering Mechanics Institute 2019 conference)
MIT News: Exploring the effects of moisture and drying on cement.

16. Capillary Stress and Structural Relaxation in Moist Granular Materials.
T. Zhou, *K. Ioannidou, E. Masoero, M. Mirzadeh, R. Pellenq and M.Z. Bazant*, Langmuir (**2019**).

15. On the IMF in a Triggered Star Formation Context.
T. Zhou, *X. Huang, D. N.C. Lin, M. Gritschneder and H. Lau, 2015*, The Astrophysical Journal(**2015**).

14. Activity-induced propulsion of a vesicle, Journal of Fluid Mechanics (**2022**).
Z. Peng, **T. Zhou**, *J.F. Brady*

13. Water sorption isotherms and hysteresis of cement paste at moderately high temperature, up to 80° C, Cement and Concrete Research (**2022**).
J. Wang, M. Yio, **T. Zhou**, *H. Wong, C. Davie, E. Masoero.*

12. A model for cooperative scientific research inspired by the ant colony algorithm.
Z. He, **T. Zhou**, PLoS ONE (**2022**).

11. Blistering Failure of Elastic Coatings with Applications to Corrosion Resistance.
S. Effendy, **T. Zhou**, *H. Eichman, M. Petr, M.Z. Bazant*, Soft Matter (**2021**).

10. Interplay of lithium intercalation and plating on a single graphite particle, Joule (**2021**).
T. Gao, Y. Han, D. Fraggedakis, S. Das, **T. Zhou**, *C.-N. Yeh, S. Xu, W. Chueh, J. Li, M.Z. Bazant*

9. The Effect of Confinement on Capillary Phase Transition In Granular Aggregates.
S. Monfared, **T. Zhou**, *J. Andrade, K. Ioannidou, F. Radjai, F. Ulm and R. Pellenq*, Physical Review Letters (**2020**).

8. Vortices of electro-osmotic flow in heterogeneous porous media.
M. Mirzadeh, **T. Zhou**, *A. Amooie, D. Fraggedakis, T. Ferguson, M.Z. Bazant.* Physical Review Fluids (**2020**, **Editors' suggestion**).

7. Dielectricbreakdown by electric-field induced phase separation.
D. Fraggedakis, M. Mirzadeh, **T. Zhou**, *and M.Z. Bazant.* Journal of The Electrochemical Society, (**2020**).

6. A scaling law to determine phase morphologies during ion intercalation.
D. Fraggedakis, N. Nadkarni, T. Gao, **T. Zhou**, *Y. Zhang, Y. Han, R. M. Stephens, Y. Shao-Horn, and M.Z. Bazant.*
Energy & Environmental Science (**2020**).

5. Modeling the Metal-Insulator Phase Transition in Li_xCoO_2 for Energy and Information Storage
N. Nadkarni, **T. Zhou**, *D. Fraggedakis, T. Gao and M.Z. Bazant*, Advanced Functional Materials(**2019**).

4. Inferring Pore Connectivity from Adsorption/Desorption Isotherms.
M. B. Pinson, **T. Zhou**, *H. Jennings and M.Z. Bazant*, Journal of colloid and interface science (**2018**).

3. Thermodynamics, Kinetics and Mechanics of Cesium Sorption in Cement Paste: a multi-scale assessment.
J. Arayro, A. Dufresne, **T. Zhou**, *K. Ioannidou, F. Ulm, R. Pellenq and L. Beland* , Physical Review Materials (**2018**).

2. Atomistic and Mesoscale Simulation of Sodium and Potassium Adsorption in Cement Paste
J. Arayro, A. Dufresne, **T. Zhou**, *K. Ioannidou, F. Ulm, R. Pellenq and L. Beland*, The Journal of chemical physics (**2018**).

1. On the Coagulation and Size Distribution of Pressure Confined Cores.
X. Huang, **T. Zhou**, *T. Kouwenhoven and D. N.C. Lin, 2013*, The Astrophysical Journal **2013**).

Honors and Awards

- Cecil and Sally Drinkward Postdoc Fellowship (2020)
- Student paper award, Engineering Mechanics Institute (2019).
- E.A. Boldt (1953) Fellowship, Massachusetts Institute of Technology (2012-2013)
- May 4th Award, Peking University (2009, 2011)
- 1st Prize, Linbridge Prize for Excellent Undergraduate Research in Astrophysics, Kavli Institute for Astronomy and Astrophysics, Peking University (2010, 2011)
- Ming-De Fellowship, Peking University, (2008-2012)

Professional Activities and Scientific Outreach

- Animal Protocol (2024) IA24-1882 Geometric design of antibacterial catheters.
- Selected publicity on anti-infection catheter design: Caltech News Report (2024).; The New York Times Report (2024); Science Times Report (2024).
- Selected publicity on cement modeling: MIT News Report (2019).
- Referee for Journal of Statistical Physics, Soft Matter, Journal of Physical Biology, New Journal of Physics, Journal of Physical Chemistry, Journal of Physics: Complexity, ACS Applied Energy Materials, Journal of Materials in Civil Engineering, Journal of Applied Geochemistry, and Water Resources Research.

Invited Seminars

- "Fractional Order Calculus and Anti-Infection Catheter Design", SISSA, International School for Advanced Studies, Italy, September 2025.
- "Living and Soft Matter: From Non-Equilibrium Phase Separation to Anti-infection Catheters", Northwestern University, US, January 2025.
- "Living and Soft Matter: From Non-Equilibrium Phase Separation to Anti-infection Catheters", University of Massachusetts at Amherst, US, January 2025.
- "Phase Transition Induced Deformation in Porous Media", School of Civil Engineering and Geosciences, Newcastle University, UK, January 2019.

Teaching Experience

- Guest lecturer for *Squishy Engineering: Using Soft Materials to Solve Hard Problems.* (ChE/Ch/MS 113), Caltech, 2025 Spring.
- Teaching Assistant for *The Early Universe* (8-286), Department of Physics, MIT, 2013 Fall.
- Teaching Assistant for *Astronomy*, School of Physics, Peking University, 2010 Summer.
- Attendence in "Design your own course" workshop, 2022, Caltech Center for Teaching, Learning and Outreach.