



## Applications in magnetic control using MagnebotiX field generators

### Magnetic locomotion and microactuation strategies

- Hongri Gu, Emre Hanedan, Quentin Boehler, Tian-Yun Huang, Arnold J.T.M. Mathijssen and Bradley Nelson. Artificial Microtubules for Rapid and Collective Transport of Magnetic Microcargoes. *Nat. Mach. Intell.* 4, 678-684 (2022).
- N Mirkhani, M Christiansen and S. Schuerle. Living, self-replicating ferrofluids for fluidic transport. *Adv. Funct. Mater.* 2020, 2003912.
- C. C. J. Alcantara, F. C., Landers, S. Kim, C. de Marco, D. Ahmed, B. J., Nelson, S. Pane. Mechanically interlocked 3D multi-material micromachines. *Nat. Commun.* 11:5957 [<https://doi.org/10.1038/s41467-020-19725-6>] (2020).

### Micromanipulation including for non-magnetic bodies

- H.-W. Tung, D. F. Sargent and B. J. Nelson. Protein crystal harvesting using the RodBot: a wireless mobile microrobot. *J. Appl. Cryst.* (2014). 47, 692-700

### Magnetic actuation in water remediation

- Roberto Bernasconi, Elena Carrara, Marcus Hoop, Fajer Mushtaq, Xiangzhong Chen, Bradley J. Nelson, Salvador Pané, Caterina Credi, Marinella Levi, Luca Magagnin. Magnetically navigable 3D printed multifunctional microdevices for environmental applications. *Additive Manufacturing* 28, 127–135 (2019)
- Mushtaq, F., Asani, A., Hoop, M., Chen, X.-Z., Ahmed, D., Nelson, B. J. and Pané, S. (2016), Highly Efficient Coaxial TiO<sub>2</sub>-PtPd Tubular Nanomachines for Photocatalytic Water Purification with Multiple Locomotion Strategies. *Adv. Funct. Mater.*, 26: 6995–7002.

### Magnetically controlled morphology

- Hongri Gu, Quentin Boehler, Haoyang Cui, Eleonora Secchi, Giovanni Savorana, Carmela De Marco, Simone Gervasoni, Quentin Peyron, Tian-Yun Huang, Salvador Pane, Ann M. Hirt, Daniel Ahmed and Bradley J. Nelson. Magnetic Cilia Carpets with Programmable Metachronal Waves. *Nat. Commun.* 11:2637(2020)

### Magnetically controlled material properties

- M. K. Hausmann, A. Hauser, G. Siqueira, R. Libanori, S. L. Vehusheia, S. Schuerle, T. Zimmermann and A. R. Studart. Cellulose-Based Microparticles for Magnetically Controlled Optical Modulation and Sensing. *Small* 16, 1904251 (2020)

### Micro-rheology in organelles

- Chengzhi Hu, Gautam Munglani, Hannes Vogler, Tohnyui N. Fabrice, Naveen Shamsudhin, Falk K. Wittel, Christoph Ringli, Ueli Grossniklaus, Hans J. Herrmann and Bradley J. Nelson. Characterization of size-dependent mechanical properties of tip-growing cells using a lab-on- chip device. *Lab on a Chip*, vol. 17: no. 1, pp. 82-90, Cambridge: Royal Society of Chemistry (2017).

## Local anisotropy in fluidic environments

- Daphne O. Asgeirsson, Michael G. Christiansen, Thomas Valentin, Luca Somm, Nima Mirkhani, Amin Hosseini Nami, Vahid Hosseini and Simone Schuerle. 3D magnetically controlled spatiotemporal probing and actuation of collagen networks from a single cell perspective. *Lab on a Chip*, 21(20) 3850-3862 (2021)

## Mechanobiology in single cells or micro-tissues

- Simone Schuerle, Sandro Erni, Maarten Flink, Bradley E. Kratochvil, and Bradley J. Nelson, Three-Dimensional Magnetic Manipulation of Micro- and Nanostructures for Applications in Life Sciences. *IEEE Transactions on Magnetism*, 49 (1), 321-330 (2013)
- Simone Schuerle, Ima Avalos Vizcarra, Jens Moeller, Mahmut Selman Sakar, Berna Özkale, André Machado Lindo, Fajer Mushtaq, Ingmar Schoen, Salvador Pané, Viola Vogel and Bradley J. Nelson. Robotically controlled microprey to resolve initial attack modes preceding phagocytosis. *Science Robotics* 2(2), eaah6094 (2017)

## In vivo studies in embryos

- Sakar, M.S., Schurle, S., Erni, S., Ullrich, F., Pokki, J., Frutiger, D.R., Ergeneman, O., Kratochvil, B.E., Nelson, B.J. Non-contact, 3D magnetic biomanipulation for in vivo and in vitro applications. 2012 Int. Symp. Optomechatronic Technologies, ISOT 2012, 6403292 (2012)

## Studies on targeted drug delivery

- L. O. Mair, G. Adam, S. Chowdhury, A. Davis, D. R. Arifin, F. M. Vassoler, H. H. Engelhard, J. Li, X. Tang, I. N. Weinberg, B. A. Evans, J. W.M. Bulte and D. J. Cappelleri. Soft Capsule Magnetic Millirobots for Region-Specific Drug Delivery in the Central Nervous System. *Front. Robot. AI* 8:702566. doi: 10.3389/frobt.2021.702566 (2021).

## Medical research

- T. Gwisai, N. Mirkhani, M.G. Christiansen, T.T. Nguyen, V. Ling and S. Schuerle. Magnetic torque-driven living microrobots for increased tumor infiltration. *Sci. Robot.* 7, eabo0665 (2022)
- Jing Huang, Yuan Liu, Jiandong Wu, Fuping Dong, Chu Liu, Jiawei Luo, Xiangchao Liu, Ning Wang, Lei Wang and Haifeng Xu. An extracellular matrix-mimicking magnetic microrobot for targeted elimination of circulating cancer cells. *Nanoscale*, 2024, 16, 624. DOI: 10.1039/d3nr03799a

## Combined techniques

- D. Ahmed, A. Sukho, D. Hauri, D. Rodrigue, G. Maranta, J. Harting and B. J. Nelson. Bioinspired acousto-magnetic microswarm robots with upstream motility. *Nature Machine Intelligence* 3, 116–124, 2021

## Interesting review papers

- Huaijuan Zhou, Carmen C. Mayorga-Martinez, Salvador Pané, Li Zhang, and Martin Pumera. Magnetically Driven Micro and Nanorobots. *Chem. Rev.* 121 (8), 4999–5041 (2021).
- Pierre E. Dupont, Bradley J. Nelson, Michael Goldfarb, Blake Hannaford, Arianna Menciassi, Marcia K. O'Malley, Nabil Simaan, Pietro Valdastrì, and Guang-Zhong Yang. A decade retrospective of medical robotics research from 2010 to 2020. *Sci. Robot.* 6 (60), eabi8017 (2021).

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