Magnetic Microrobots for Biomedical Applications

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An emerging family of robotic systems are untethered magnetic micro- and nanorobots, tiny vehicles that can move in their swimming environments by means of magnetic fields. One of the ultimate goals of small-scale robotics is to develop machines that can deliver drugs, or realize other medical missions in confined spaces of the human body [1]. Other applications include water remediation or "on-the-fly" chemistry. The recent rapid developments in small-scale robotics are undeniably related to advances in material science and manufacturing. However, while many applications have been demonstrated, aspects such as complex locomotion, multifunctionality, biocompatibility and biodegradability need to be further investigated for the successful translation of these devices to real applications. To this end, new material-based concepts and novel fabrication schemes are urgently required. In this talk, I will introduce two of our latest developments in small-scale robotics. In the first part, we will show how 3D printed microtemplates can be exploited to produce complex robotic microstructures made of rigid metals, soft polymers and combinations of these. As a result, topologically complex metal-organic structures can be realized with micrometric resolution. The second part of this talk will be focused on multiferroic small-scale robots. These small-scale robots consist of multiferroic magnetoelectric composite materials, which have the ability to generate an electric field under the application of an external magnetic field. Micro and nanorobots capable of wirelessly delivering electric fields can be used for electrostimulation of cells for the central nervous systems applications.

References

[1] B. J. Nelson, S. Pané; *Science*, 2023, *382*, 1120-1122.