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Microfluidics for the physical assembly of life-like microsystems

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12.00 p.m.

CIC biomaGUNE - Seminar Room

The construction of synthetic cells from elementary ingredients requires both a deep understanding of the functions and molecules involved in living process and new technologies for the assembly of these functions in man-made systems. Microfluidics provides the essential tools for the creation and manipulation of micro-compartments, their tailored functionalization and their analysis in large populations. We design, develop, characterize and use microfluidic systems for the control of soft matter and biochemical systems and their integration in synthetic cells.

We focus on complex metabolic cycles miniaturized in micro-compartments. Our goal is to demonstrate that these metabolic cycles can function at small scale and can be – in the long term – further integrated with other functions characteristic of living systems. Our bottom-up integration led to the creation of man-made compartments that function under out-of-equilibrium conditions, by internally balancing chemical reactions in a steady-state, by importing and releasing chemicals as fuel and waste and by harvesting light to fuel metabolic chemical conversions.

In the long run these tools will both lead to the development of methods and systems of practical, industrial and therapeutic interest but also as experimental tools usable to test hypothesis on the emergence of life from the non-living.

References

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(2) Sequential bottom-up assembly of mechanically stabilized synthetic cells by microfluidics, M. Weiss, J. P. Frohnmayer, L. T. Benk, B. Haller, J.-W. Janiesch, T. Heitkamp, M. Boersch, R. B. Lira, R. Dimova, R. Lipowsky, E. Bodenschatz, J.-C. Baret, T. Vidakovic-Koch, K. Sundmacher, I. Platzman & J. P. Spatz, Nature Materials, 17, 89-96 (2018)

(3) Light-powered CO2 fixation in a chloroplast mimic with natural and synthetic parts, T. E. Miller, T. Beneyton, T. Schwander, C. Diehl, M. Girault, R. McLean, T. Chotel, P. Claus, N. Socorro Cortina, J.-C. Baret, T.J. Erb, Science 368, 6491, pp. 649-654 (2020)