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Accelerated Ripening in Chemically Fueled Emulsions

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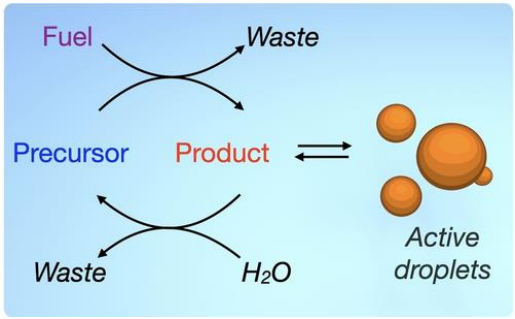

Who are the corresponding authors and what are their research areas?

The corresponding authors are:

1) Christoph A. Weber:

He is Group Leader at the Max Planck Institute for the Physics of Complex Systems and the Center for System Biology, in Dresden. He is a physicist, involved in the study of the physics underneath phase transitions in biological systems, in mechanisms of intra-cellular organization and physical principles underlying the origin of life.

2) Job Boekhoven:

He is Assistant Professor at TUM of Munich (Germany). He is a supramolecular chemist. He is a leader in the study of chemically fuelled reaction cycles and, in general, in out-of-equilibrium systems mimicking life-like assemblies to form transient materials and droplets.

What is the main claim of the article?

Main claim: The groups have developed synthetic and chemically-fueled emulsions, in which the droplets arise in the moment a proper chemical fuel is supplied. They consequently decay when the fuel is consumed. The main claim is the fact that these droplets grow (that's to say get bigger and bigger) following a trend similar to the Ostwald ripening, but two order of magnitude faster. Using theoretical and experimental data, the authors can confirm that the rapid growth of bigger droplets at expense to smaller ones is based on a combination of both Ostwald ripening and fuel-driven reaction cycle.

Relevance: The droplets shown here are the prodrome of more complex structures present in nature and biological systems (i.e. cells). The mechanism underneath their synthesis and preparation could be relevant for the control of growth, speed and size of membrane-less organelles in living cells and could represent a new strategy of controlling nanostructures out-of-equilibrium.

How is it demonstrated?

Demonstration: The main demonstration of the growth mechanism is proofed by HPLC (after a previous calibration for every chemical species present during each experiment) and confocal fluorescence microscopy (using a Nile Red as dye to track record the droplets). Moreover, the mechanism is corroborated by theoretical models.

What are the typical experimental conditions?

The typical conditions are the following:

- Stock solutions of the precursors prepared by dissolving the starting material in MES buffer and adjusting the pH to 6.0. Concentrations of the MES buffer are variable, depending on the concentration of the starting material (200 mM MES buffer for 10 mM (and below) starting material; 500 mM MES buffer for higher concentrations of the starting materials)
- 1M EDC used freshly.

The experiments of growth and decay of the droplets take usually from 1 to 3 hours, depending on the starting materials employed.

Which are the key related papers?

M. Tena-Solsona et al.**, Self-selection of dissipative assemblies driven by primitive chemical reaction networks,** Nat. Commun. 2018, 9, 2044 https://doi.org/10.1038/s41467-018-04488-y

Previously, the same group studied how the chain length of the acid/anhydride influences the formation of the droplets

Donau et al., ***Active coacervate droplets as a model for membraneless organelles and protocells***, Nat. Commun. 2020, 11, 5167 https://doi.org/10.1038/s41467-020-18815-9