Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Generation and self-assembly of multiple droplets inside microchannels JAN GUZOWSKI, PIOTR KORCZYK, Institute of Physical Chemistry, Polish Academy of Sciences, SLAWOMIR JAKIELA, PIOTR GARSTECKI, Institute of Physical Chemistry, Polish Academy of Sciences, MICROFLUIDICS AND COMPLEX FLUIDS GROUP TEAM — When two immiscible microscopic droplets immersed in a host fluid phase are brought into contact three different equilibrium topologies can form. Depending on the relative values of the three possible interfacial tensions one observes either complete engulfing of one drop by the other one, partial engulfing in which all three possible interfaces are present or non-engulfing when the drops remain separated by the host phase. In the case of multiple drops these surface interactions lead to self-assembly of complex stable and metastable architectures corresponding to local minima of the total interfacial energy. We study those equilibrium configurations experimentally by using automated microfluidic devices in which droplets are generated and merged on-demand inside microchannels. Guided by theoretical considerations and numerical energy minimization we propose stability diagrams spanned by ratios of surface tensions and volume fractions. We also explain how linear sequences of droplet volumes generated inside narrow microfluidic channels relax, after entering a wide chamber, towards given two- or three-dimensional architectures. Our findings provide routes towards synthesis of polymeric particles with predesigned internal structure and may find use in generation of autonomous droplet networks with application as biosensors.

Jan Guzowski
Institute of Physical Chemistry, Polish Academy of Sciences

Date submitted: 24 Sep 2012 Electronic form version 1.4