Tailored combinatorial microcompartments via self-organization of microobjects: Assembly, self-sorting, dynamic reconfiguration and cell studies

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The fabrication and characterization of advanced 3D cell culture microenvironments that enable systematic structure - property relationship studies are reported [1,2]. The asymmetric multifunctional 3D cell microenvironments were obtained by capillary force-assisted assembly of microscale cubes at the water/air interface. The identical wettability of distinctly different microcubes, which exhibit different surface chemical functionalities or topographic nanostructures, drives the self-assembly into close-packed hexagonal aggregates with randomly arranged cubes. Hence with a library of a limited number of building blocks a very large number of distinct microenvironments with a unique trigonal pyramidal structure can be obtained in a combinatorial manner.

This work is based on the systematic investigation of the dependence of the orientation of microscale PS cubes, which are surface functionalized on only 5 faces, at the water/air interface and the ordered aggregates formed by capillary force assembly [2,3]. Depending on the wettability of the faces, the cubes were shown to adopt a preferred orientation that changes with decreasing wettability from face up to edge up and further to vertex up. Concomitantly stable aggregates with different structures were formed by capillary force self-assembly. Finally, self-sorting of differently surface functionalized microcubes as well as dynamic reconfiguration of the assemblies by changing the surface tension of the subphase [4] was realized for the first time.

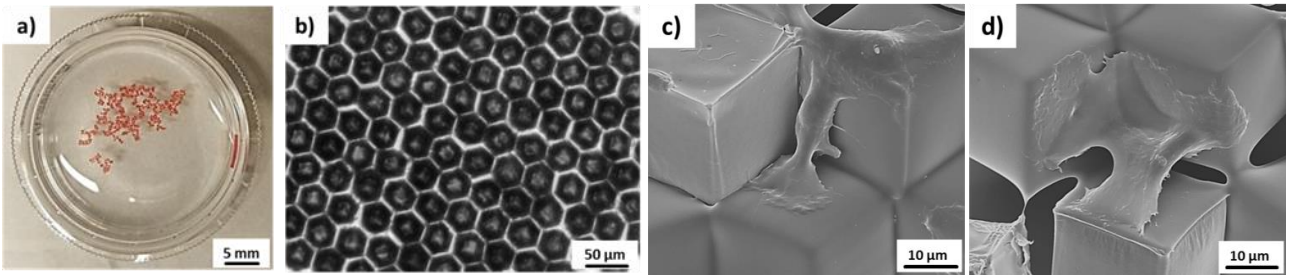

Figure 1. Fig. 1 a), b) Optical microscopy images of self-assembled cube aggregates (= 102°) with close-packed hexagonal structure at the water/air interface [2]. (c,d) SEM images of fixed Patu 8988T cells attached inside of microwells contained c) one and d) zero PAAm modified surfaces, respectively [3].

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