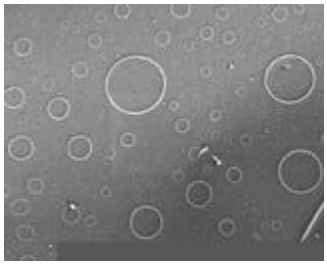
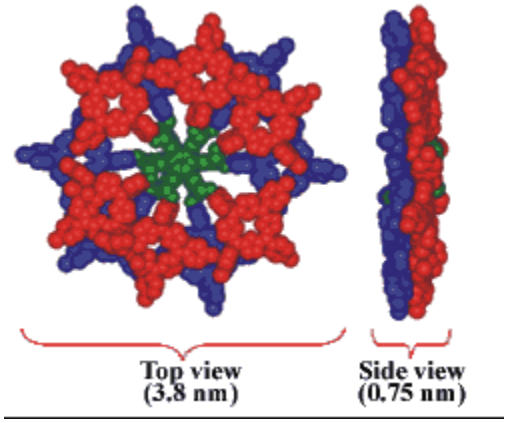
Source http://www.vcbio.sci.kun.nl/eng/fesem/applets/porphyrin/

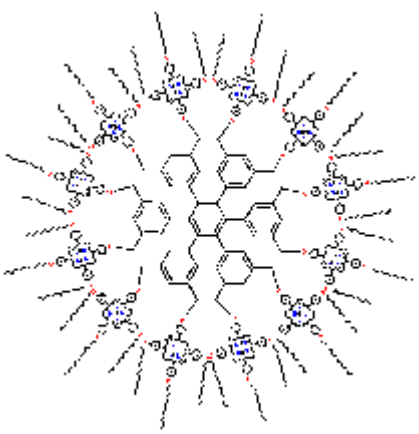
Porphyrin rings: self-assembling catalyst molecules



Click on the gray image to load the virtual FESEM or open a new window. The FESEM simulator works with Java. If the required Java (TM) plug-in 1.3 is not installed yet on your computer, you will be automatically redirected to Sun Microsystems, Inc. Follow the (simple) step-by-step instructions to download the free plug-in. After completion of the installation procedure the virtual FESEM will be launched automatically.

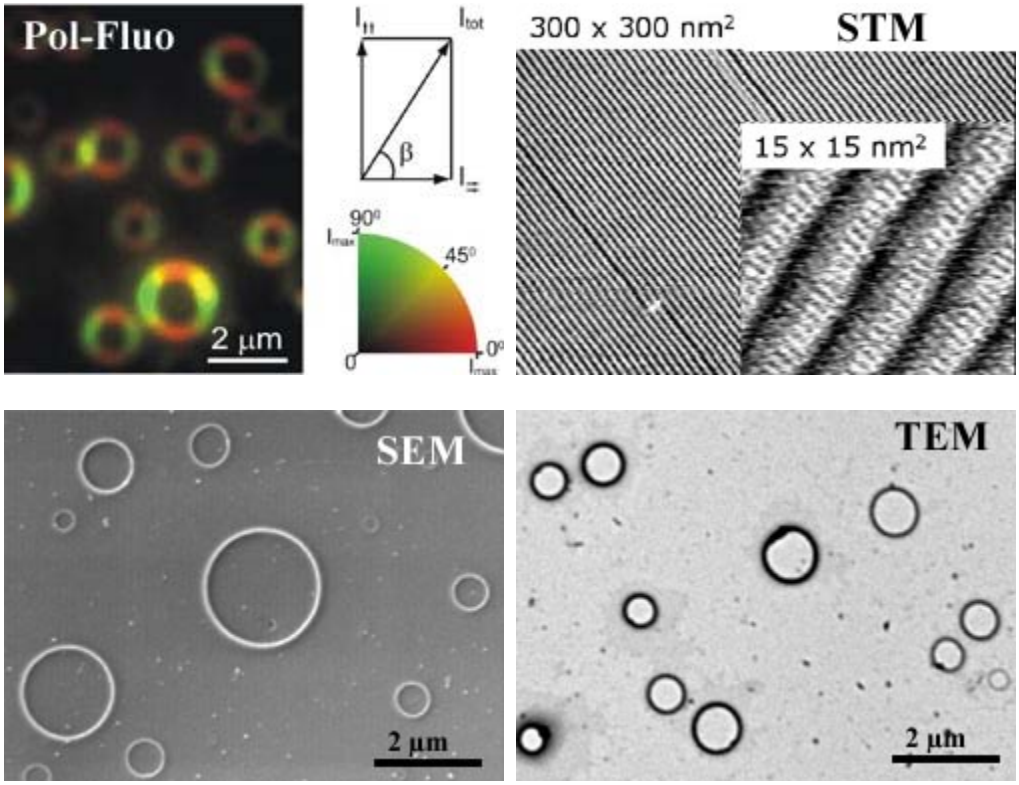
In nature, chemical reactions are catalysed by several enzymes. (A catalyst is a substance that accelerates a chemical reaction without being consumed in the process). Those catalytic enzymes often employ porphyrins in the active site for the catalytic function. One example is the enzyme Cytochrome P-450 that can catalyse oxidation reactions. In the laboratory for Organic Chemistry (University of Nijmegen) artificial, bio-inspired catalysts are developed that also consist of porphyrins. Each molecule contains 12 porphyrins (a dodecamer) that are bound to a central core molecule. These giant molecules have the shape of a disc (diameter: 38 Å = 3.8 nm) and the molecular weight (15 kDa) is comparable to that of small proteins.



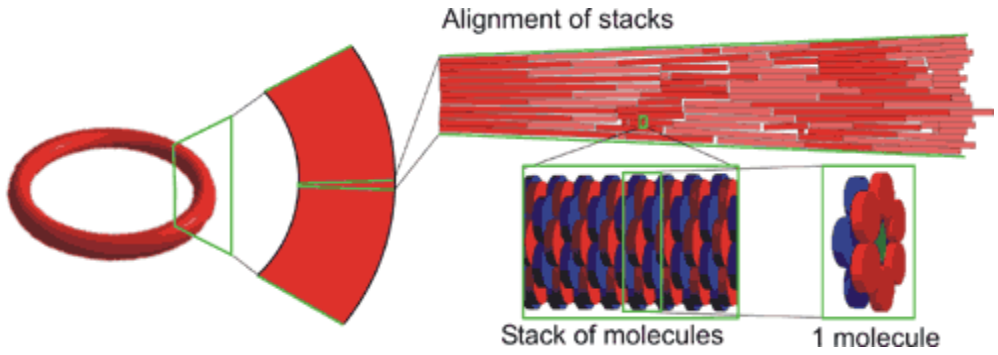


Click on start for an animation: rotation of a porphyrin molecule from side to front view(192 KB)

By their specific design, these porphyrin dodecamers have self-assembling properties. On carbon-coated copper grids these molecules form micro-meter sized, stable, solid rings. Supramolecular interactions between the porphyrins (so-called pi-pi-stacking) are the driving force to form these structures. The rings were imaged and investigated by transmission (TEM)- and scanning electron microscopy (SEM). Besides, the precise orientation of the individual molecules within the rings was determined by applying polarized fluorescence microscopy (Pol-Fluo); the different colors of the emitted light correlate with the orientation of the molecules. The aggregation of the molecules into stacks has been visualized by scanning tunneling microscopy (STM; surf to the Scanning Probe Microscope). (Research project of Marga Lensen)



Since the interior of the rings is empty, nanotechnology researchers of the University of Nijmegen intend to use these structures as containers. They want to fill the rings with substrate solutions and perform catalysis on the surface using the porphyrins in the rings as catalysts. The catalytic reaction of interest is the epoxidation (a chemical reaction in which an oxygen atom is inserted in the double bond of an alkene) that the enzyme Cytochrome P-450 catalyses in nature. Cytochrome P-450 is found in human in the liver, where it is responsible for the conversion of toxic compounds into harmless substances.



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latest update: 19 May 2004

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