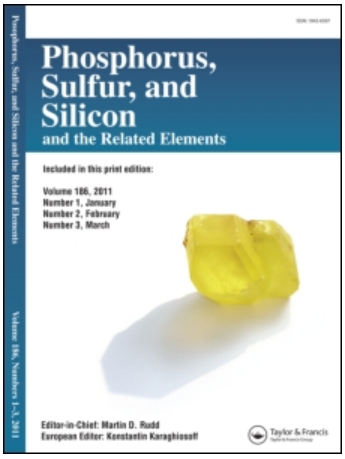


## Phosphorus, Sulfur, and Silicon and the Related Elements

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# Microtubules from Fluorinated Phosphorylated Amphiphiles in Aqueous/Alcoholic and Non-Aqueous Solvents

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# MICROTUBULES FROM FLUORINATED PHOSPHORYLATED AMPHIPHILES IN AQUEOUS/ALCOHOLIC AND NON-AQUEOUS SOLVENTS

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Phospholipids are known to self-organize into bilayer membranes and liposomes. Recently, much attention has also been focussed on highly ordered cylindrical, bilayer-based hollow microstructures usually called tubules, that form, for example, from diacetylenic phosphatidylcholines [1]. However, despite the potential of these new supramolecular architectures in both fundamental and applied area, only few tubule-forming surfactants have been reported yet. We have shown that the driving force required to form and stabilize coiled membranes in water can be brought by fitting amphiphiles with a single fluorinated chain, without need for rigid segments, hydrogen bonding between polar head or chiral centers [2,3].

We now report the formation of multilayered tubular edifices from perfluoroalkylated dimorpholinophosphoramidates, $C_nF_{2n+1}(CH_2)_2OP(O)[N\square O]_2$, n = 8, 10, in ethanol or methanol or glycerol/water mixtures, as well as in dimethylformamide. Well-developed tubules, as shown phase contrast optical microscopy and negative staining transmission electron microscopy (10-20 μm, Φ: 0.5-2 μm, fig. 1), are obtained, for example, using a 2/1 ethanol/water ratio. These tubules are very robust and retain their morphology after centrifugation, drying and resuspension in an alcohol/water mixture. In DMF, it was possible to monitor the formation of isolated tubules by progressive rolling-up of planar bilayer sheets. Reversible interconversion of the tubules into giant multilayered vesicles was observed upon heating.

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[2] F. Giulieri, M.P. Krafft, J.G. Riess, *Angew. Chem. Int. Ed.* 1994, **33**, 1514.
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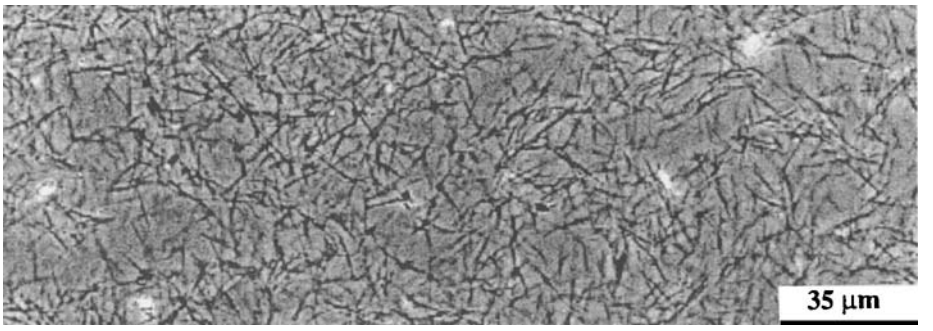


FIGURE 1: Fluorinated tubules obtained from $EtOH/H_2O$ medium.