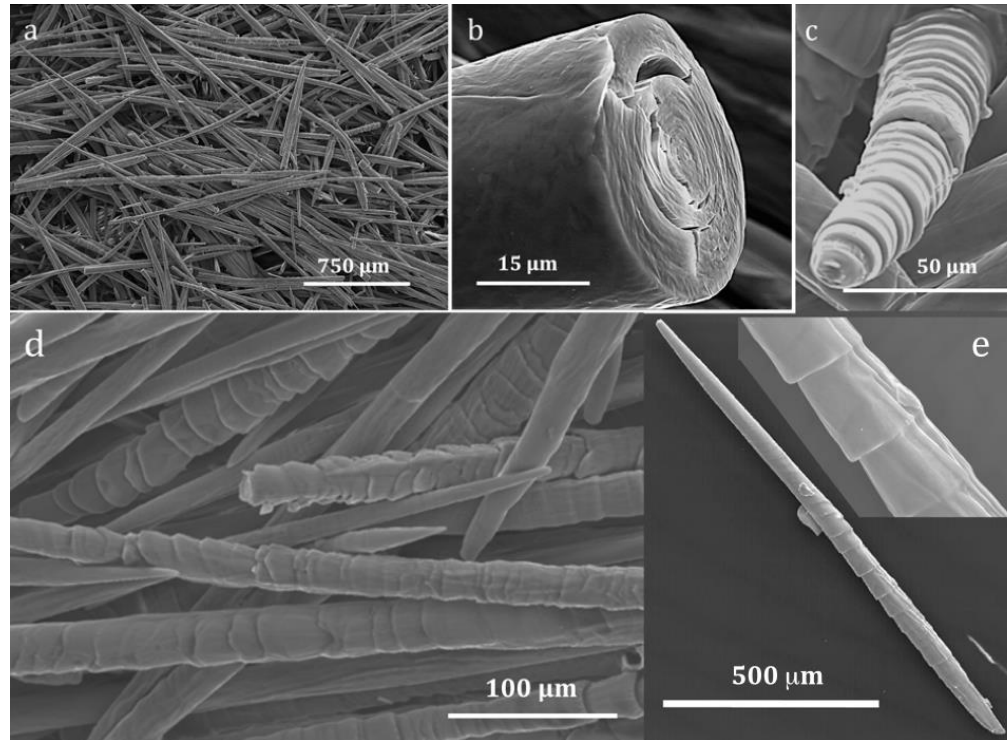


Thermal rectification in micro-sized harpoons made of polyoxometalate-hybrids



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Taipei, Oct. 2018

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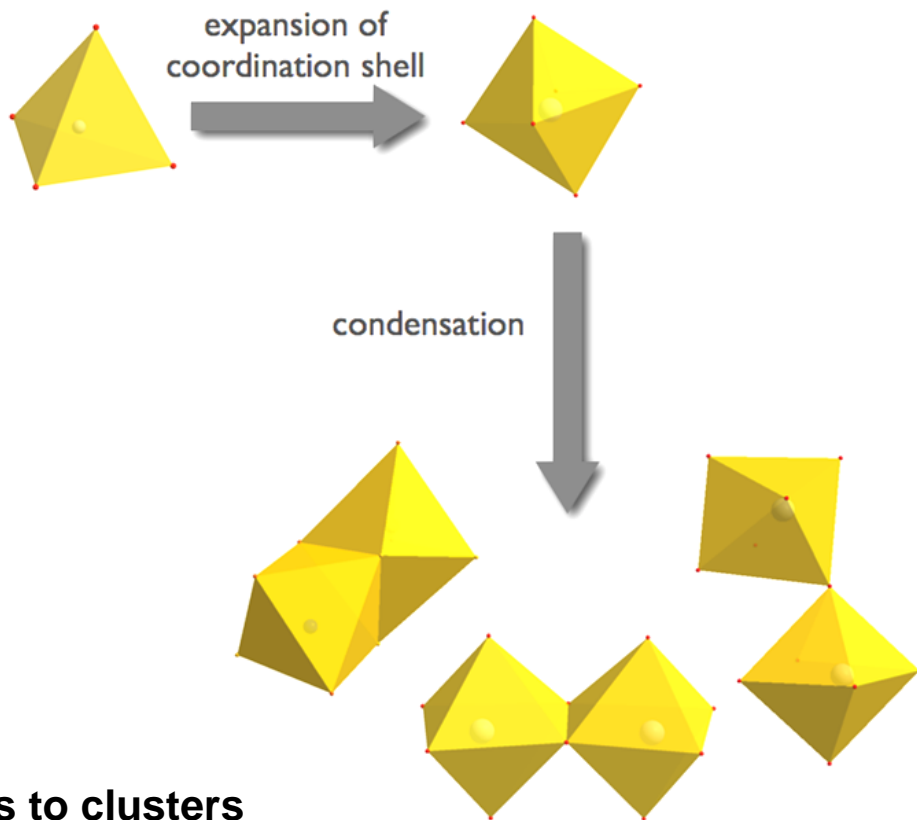
In this presentation:

Context: Polyoxometalates (POMs)

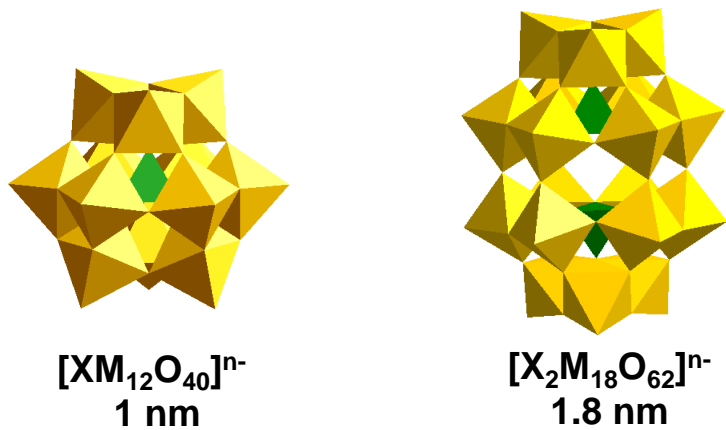
Exploring Morphologies with POM-hybrids

Heat Conduction in POM-hybrid harpoons

Polyoxometalates (POMs): lego clusters



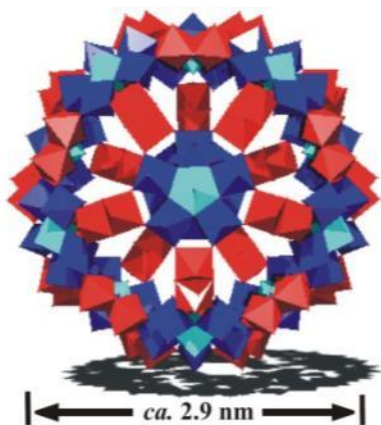
Atoms to clusters



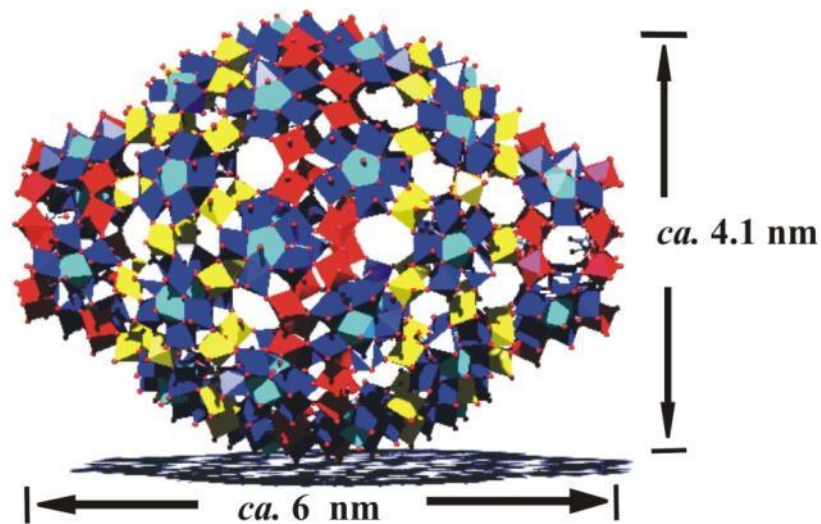
Clusters to crystals

Polyoxometalates (POMs): lego clusters

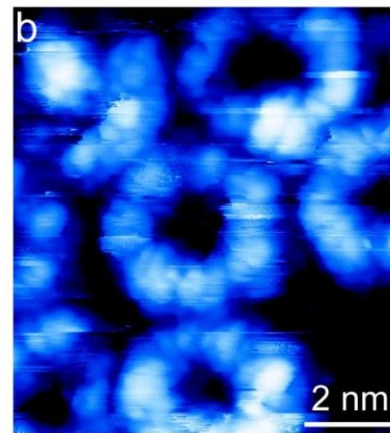
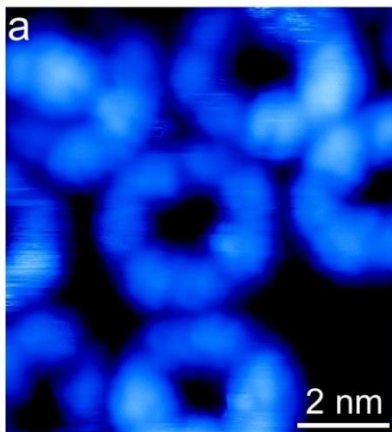
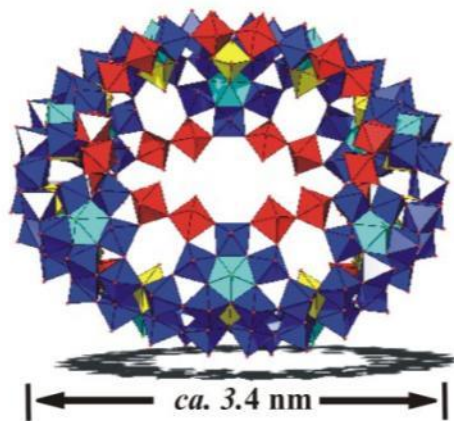
$\{\text{Mo}_{132}\}$



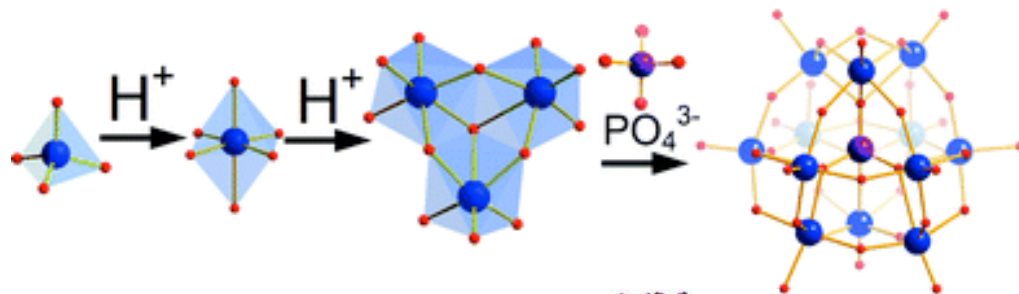
$\{\text{Mo}_{368}\}$



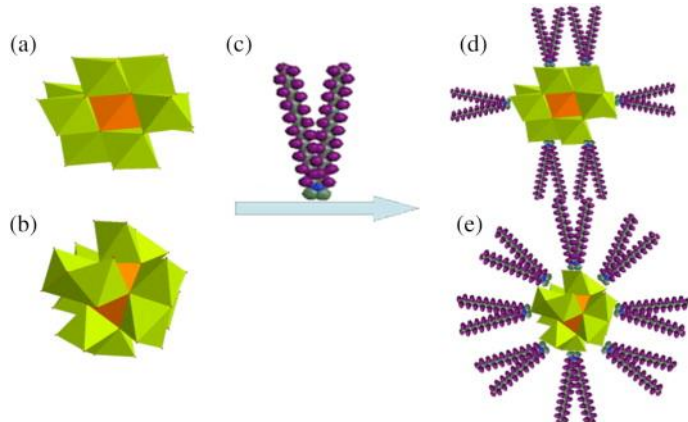
$\{\text{Mo}_{154}\}$



POM + organic chains = POM-based hybrids: a soft lego

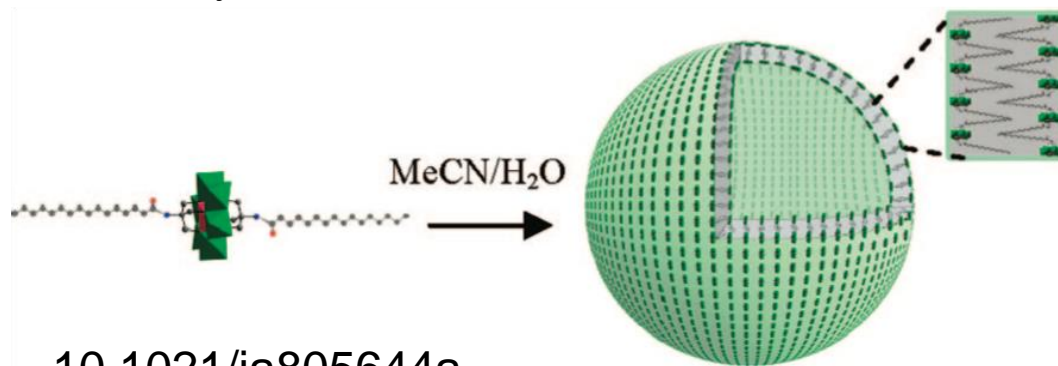


Atoms to clusters



Clusters to POM-based hybrids

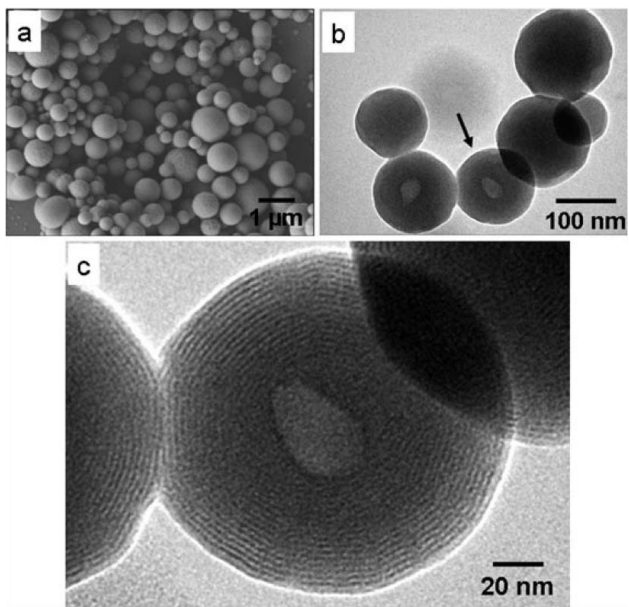
10.1016/j.inoche.2014.01.015



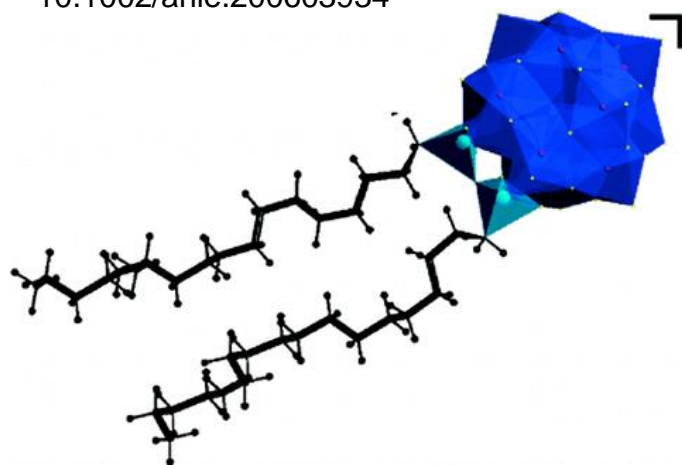
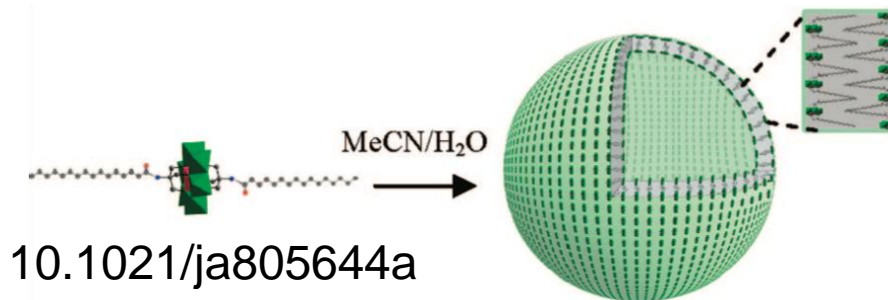
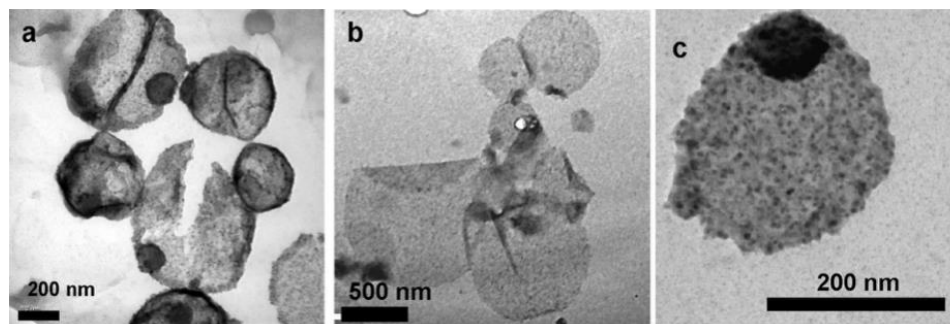
Hybrids to microstructures

10.1021/ja805644a

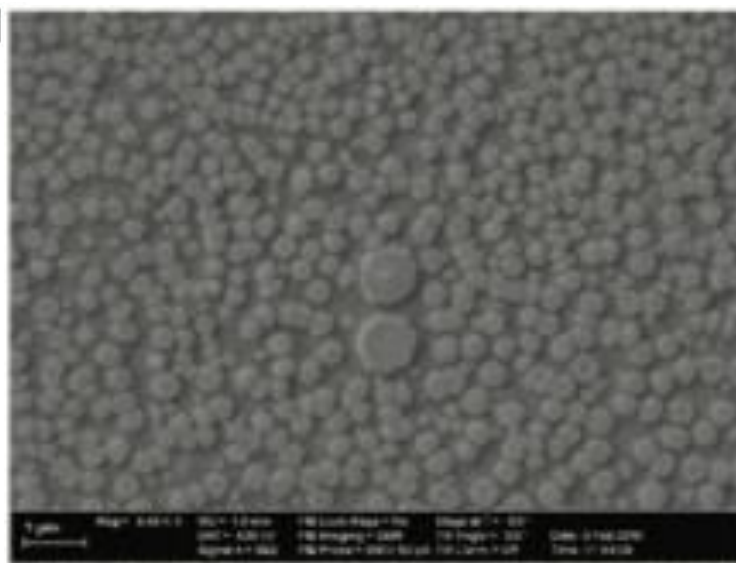
Previously on POM-based hybrids



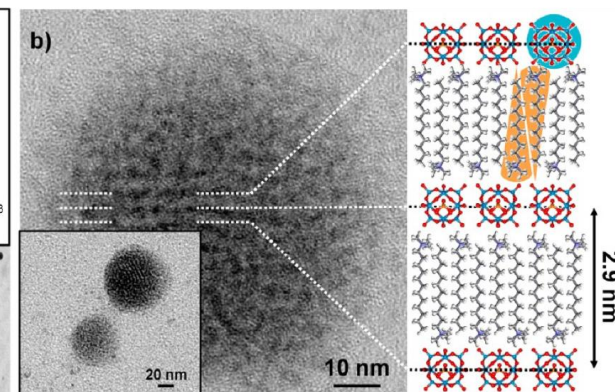
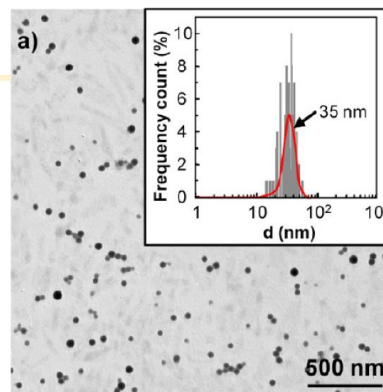
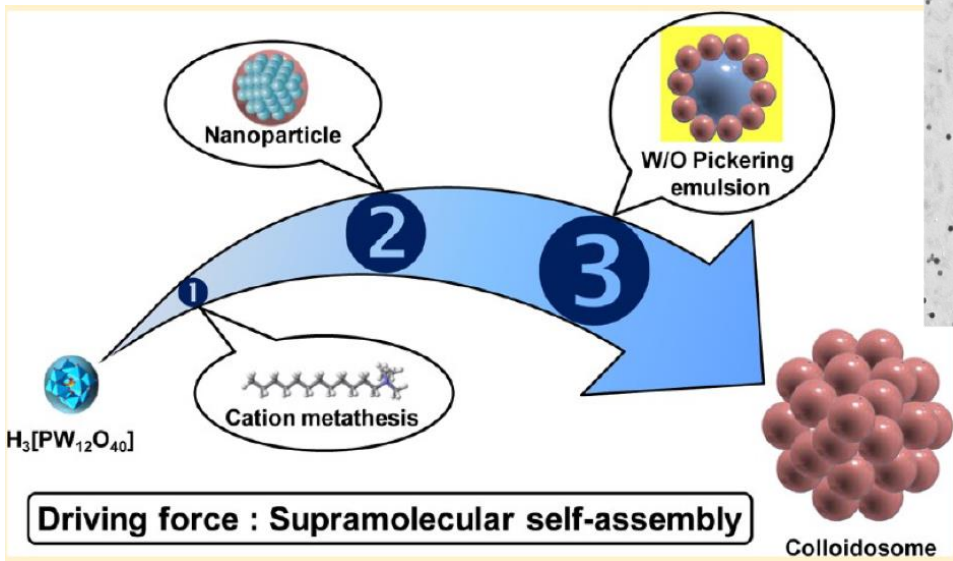
10.1002/anie.200603934



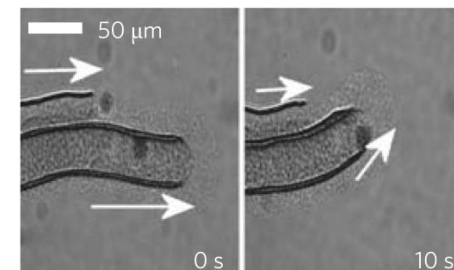
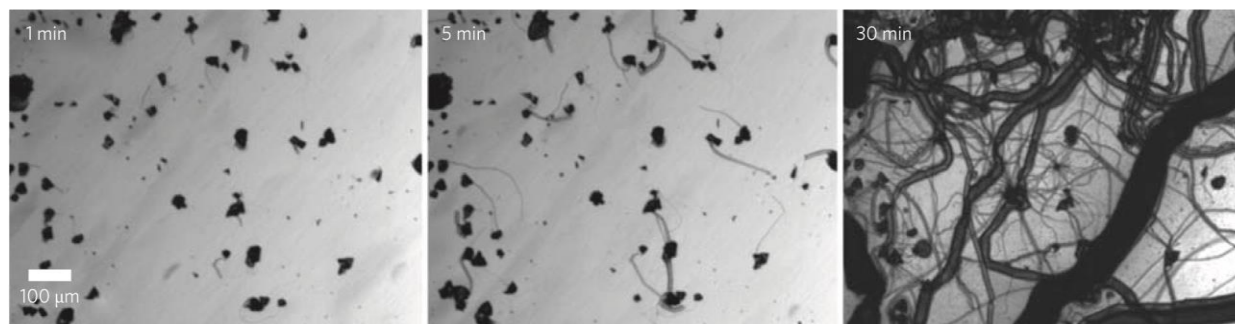
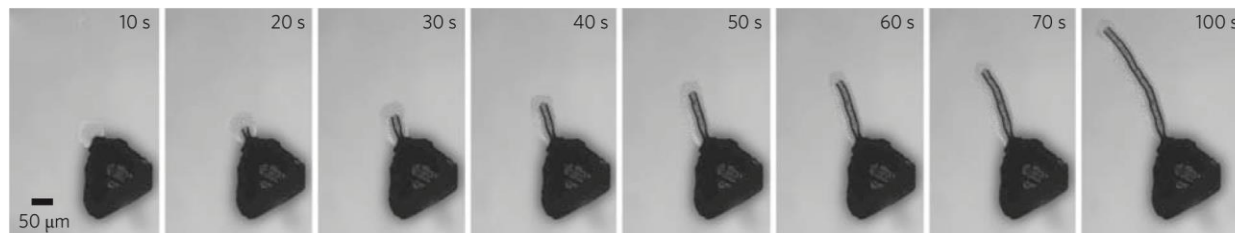
10.1021/ja1011178



Previously on POM-based hybrids

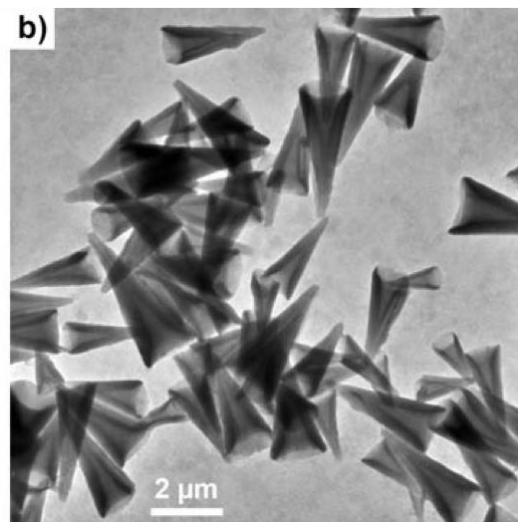
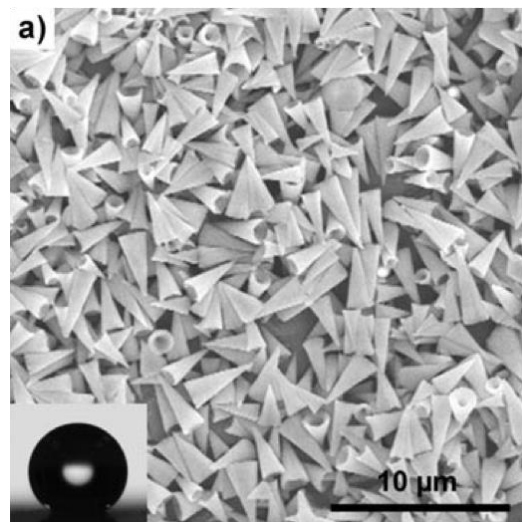


[dx.doi.org/10.1021/la500393s](https://doi.org/10.1021/la500393s)

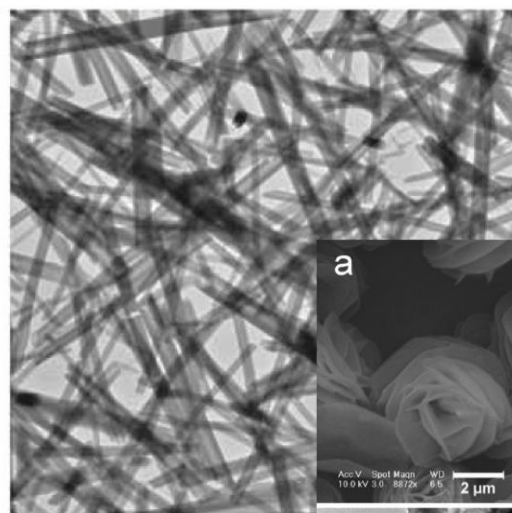
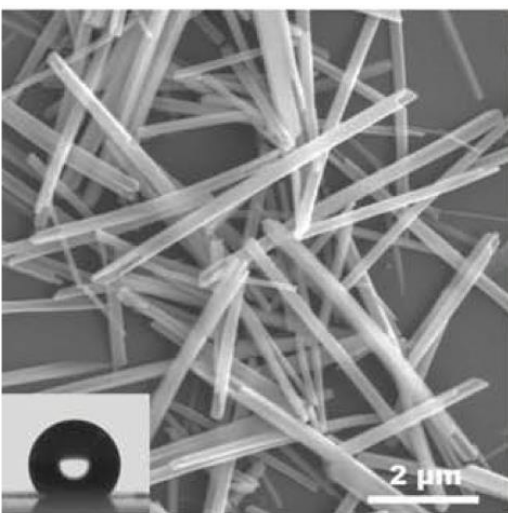


10.1038/NCHEM.113

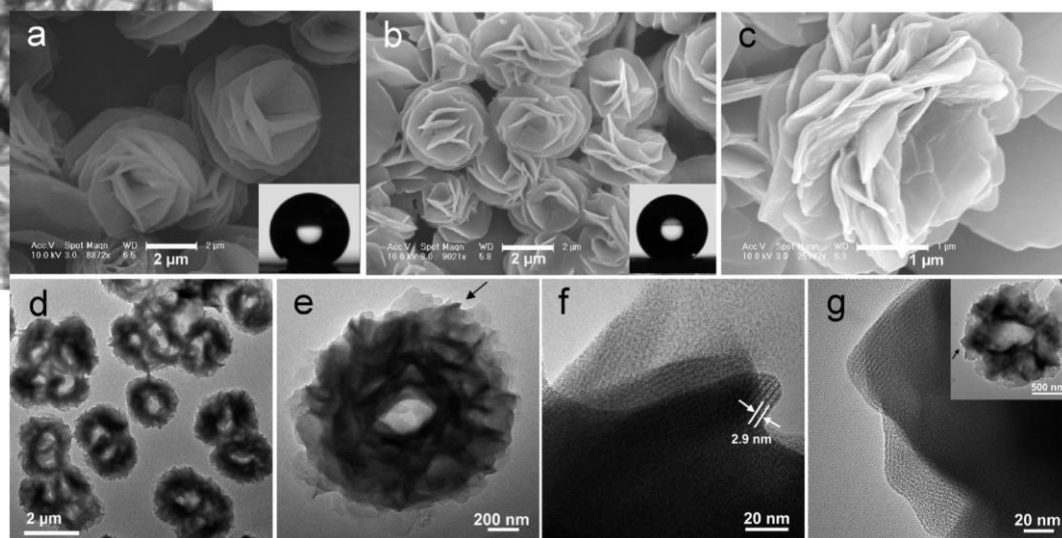
Previously on POM-based hybrids



10.1002/anie.201006155

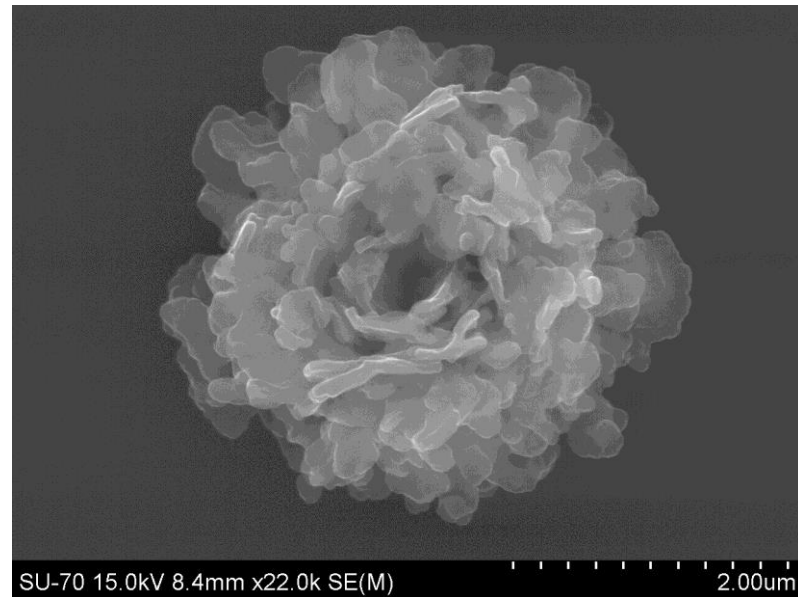
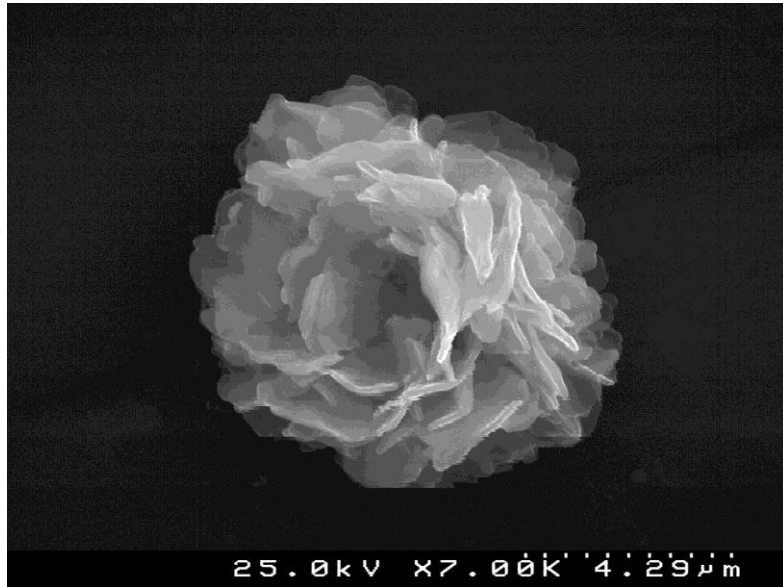
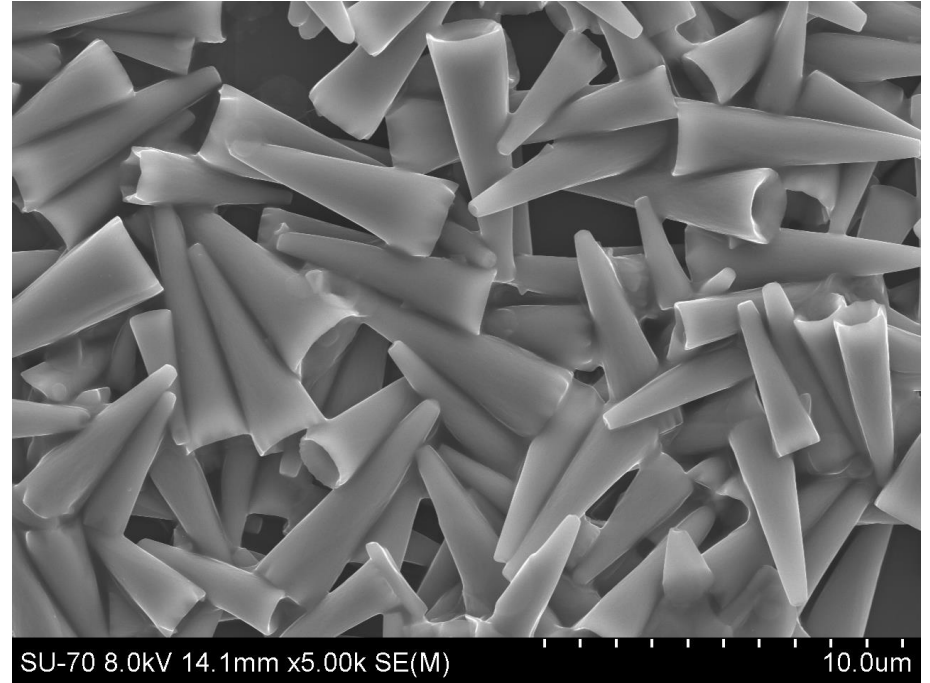
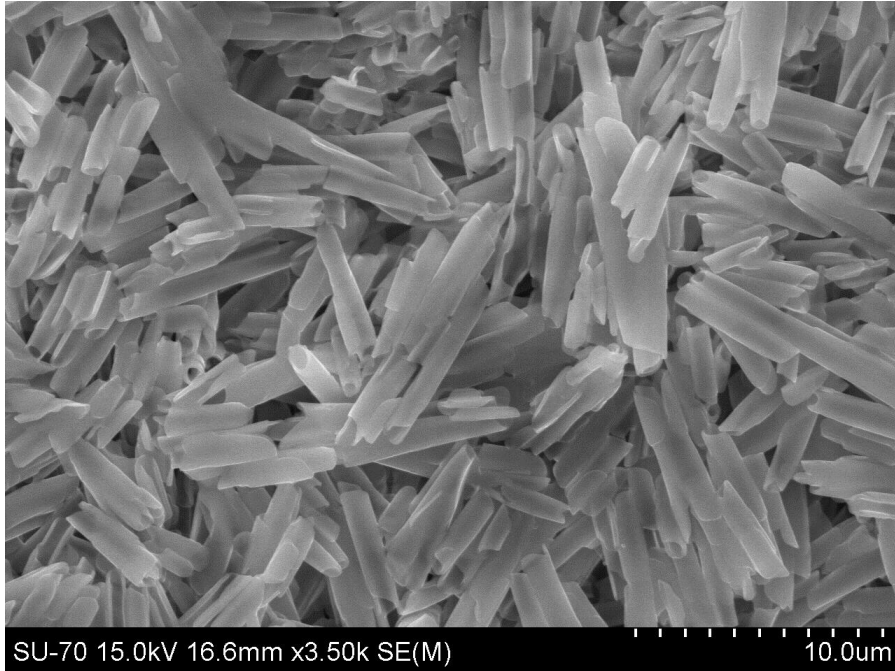


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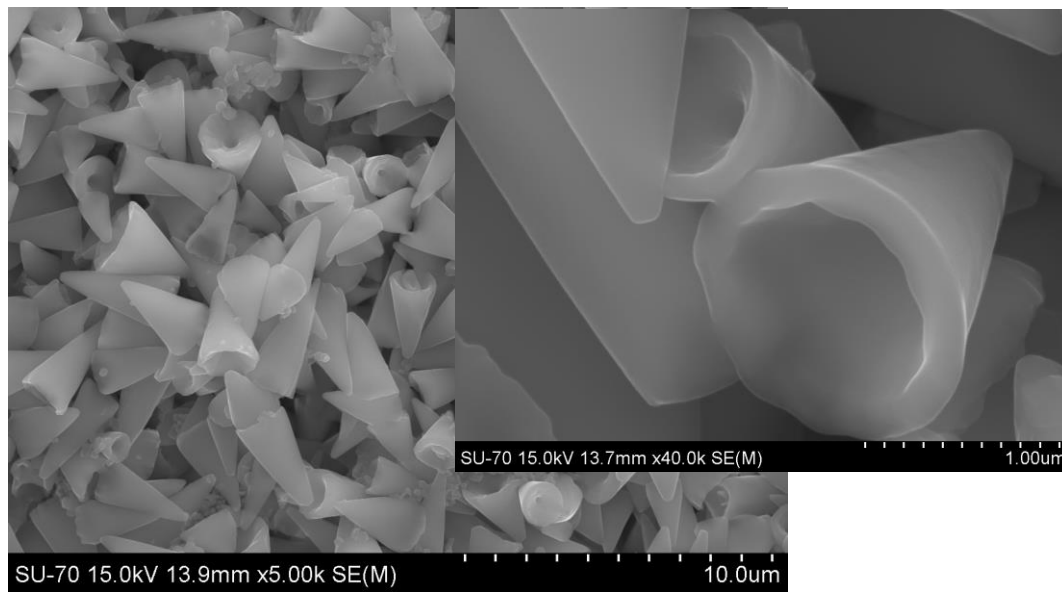
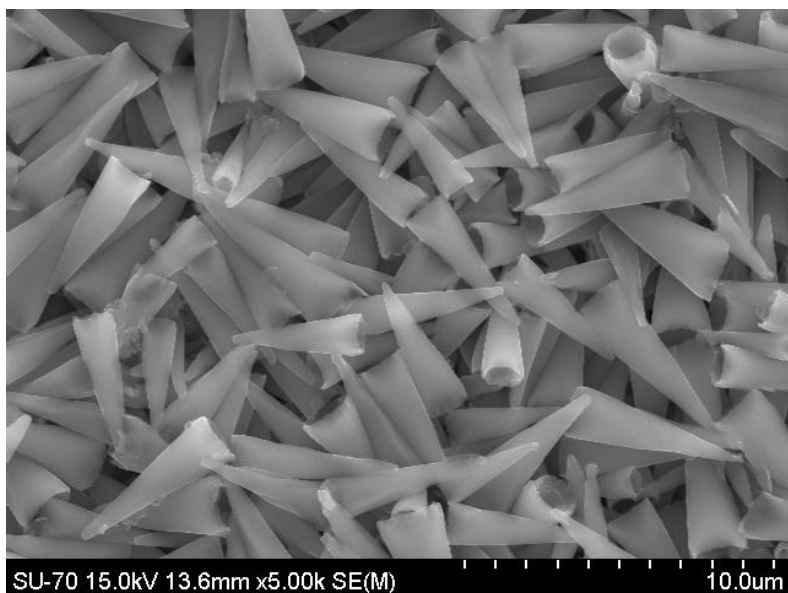
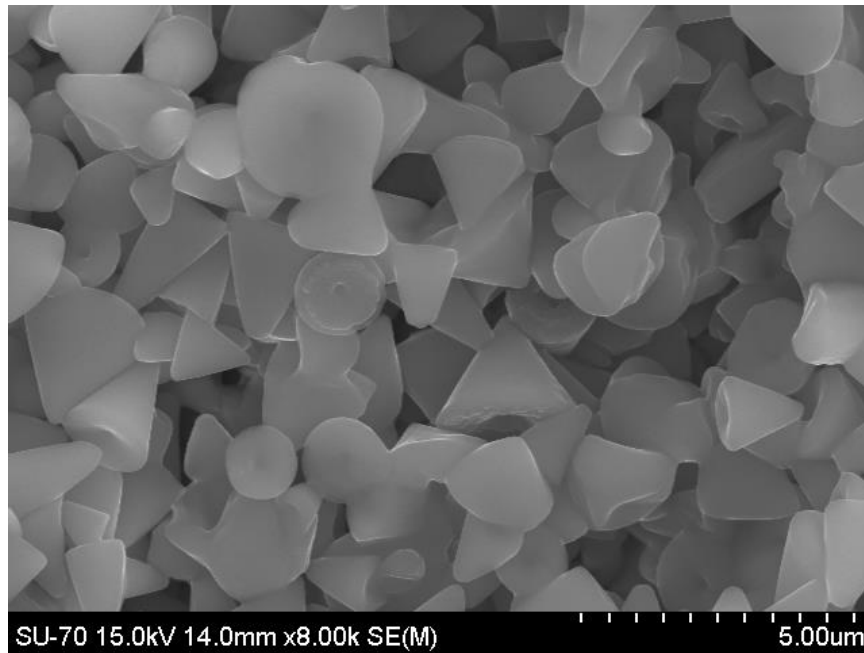
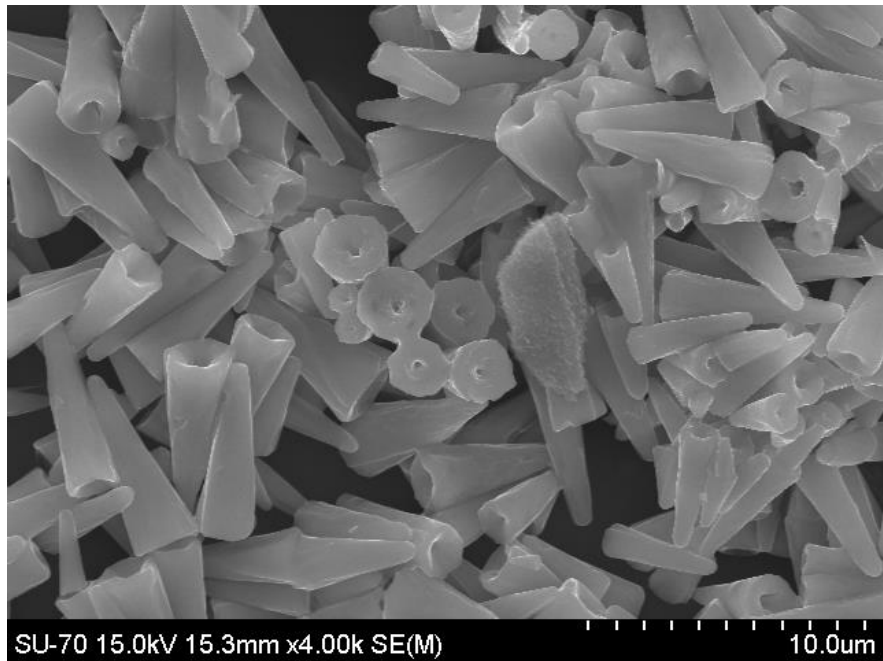


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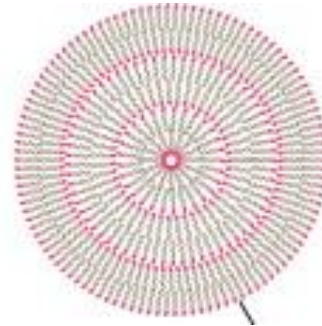
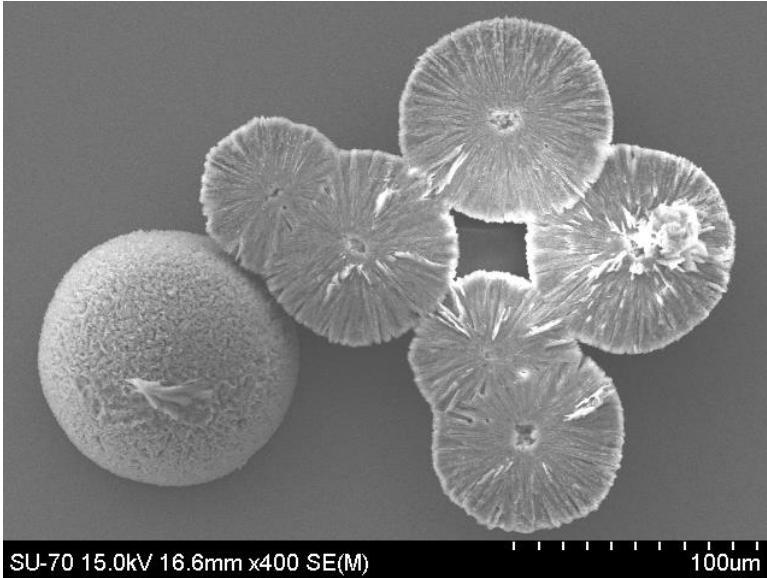
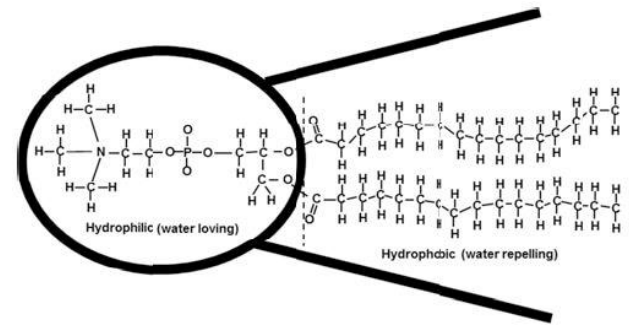
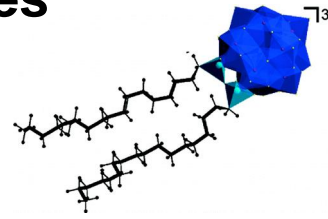
The reproductions



Extended control on The reproductions

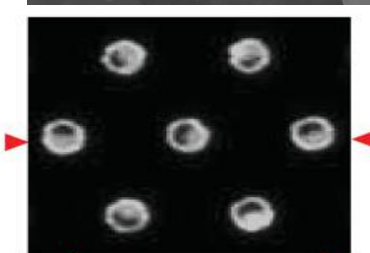
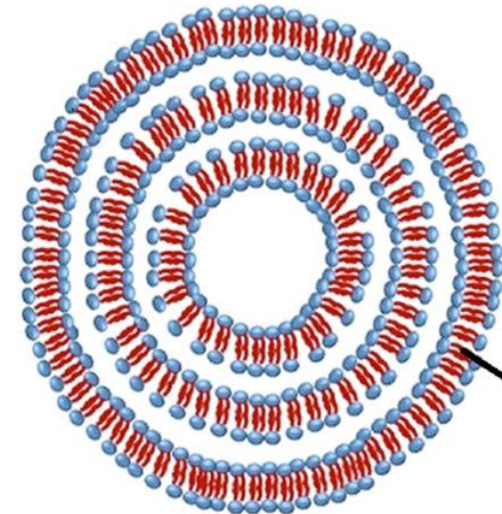
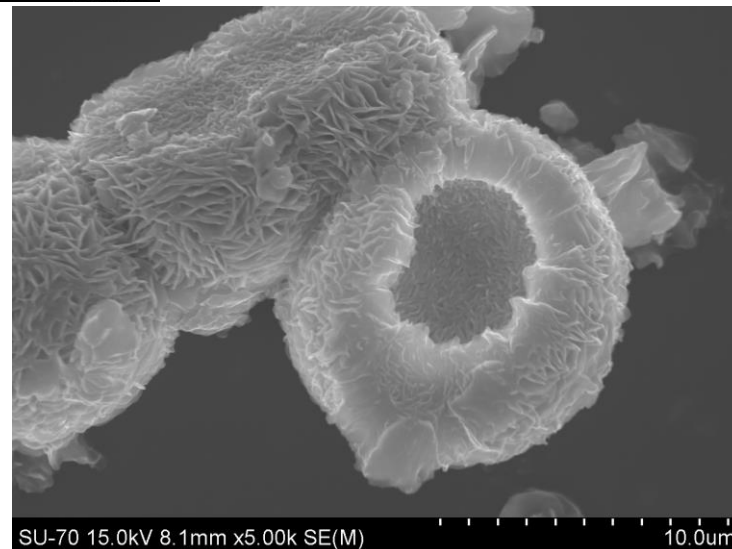
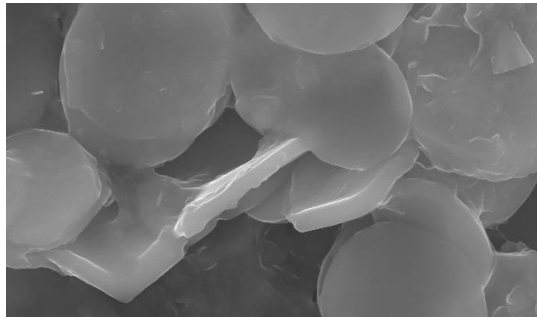


The liposomes/polymerosomes classics



10.1016/j.bbamem.2017.01.015

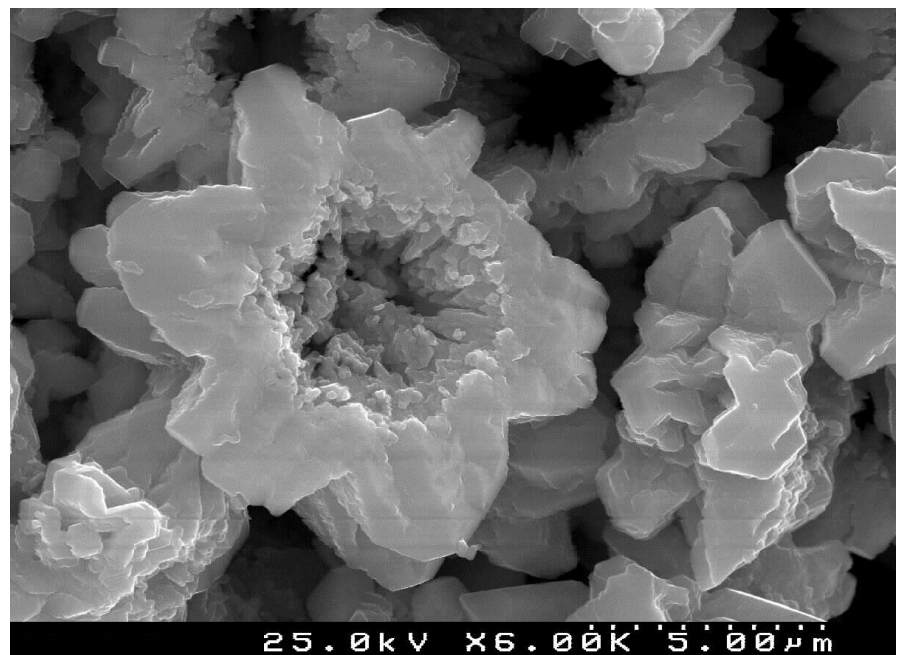
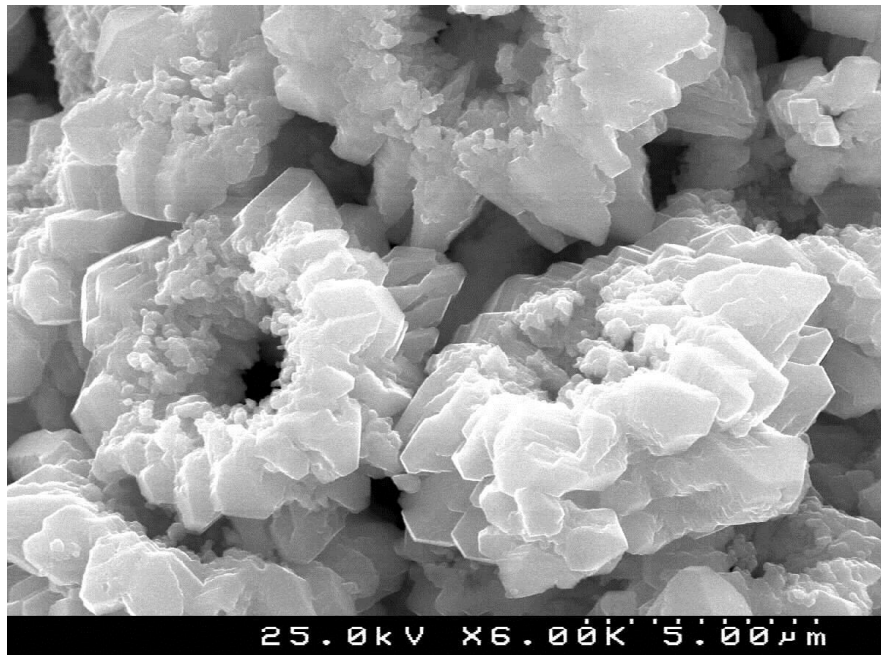
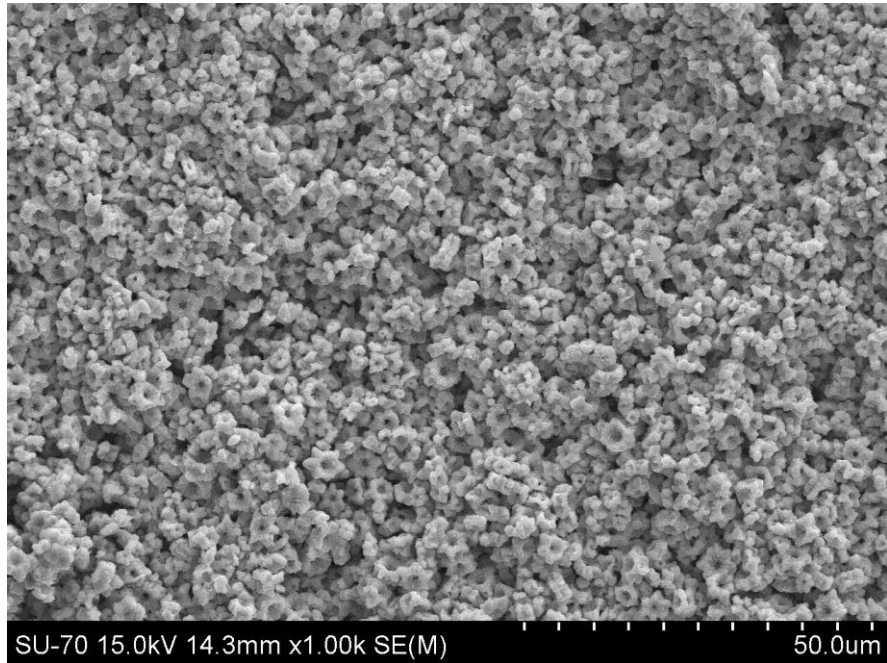
Multilamellar Vesicles (MLV)



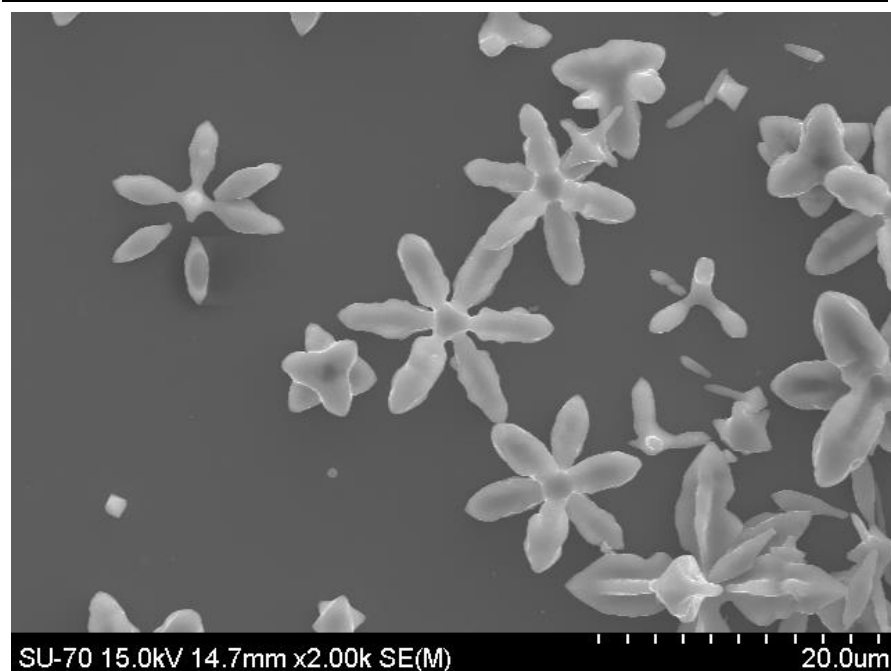
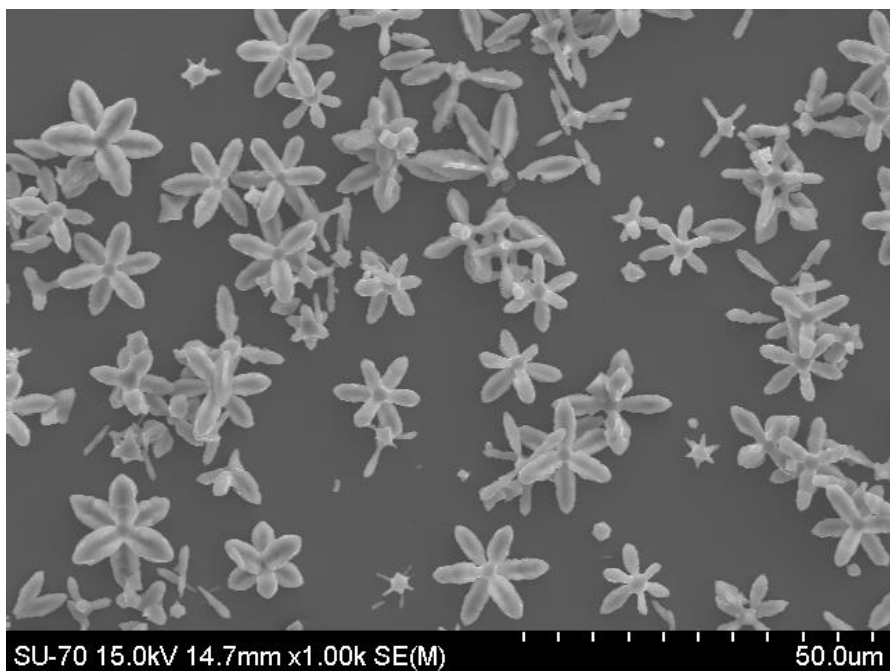
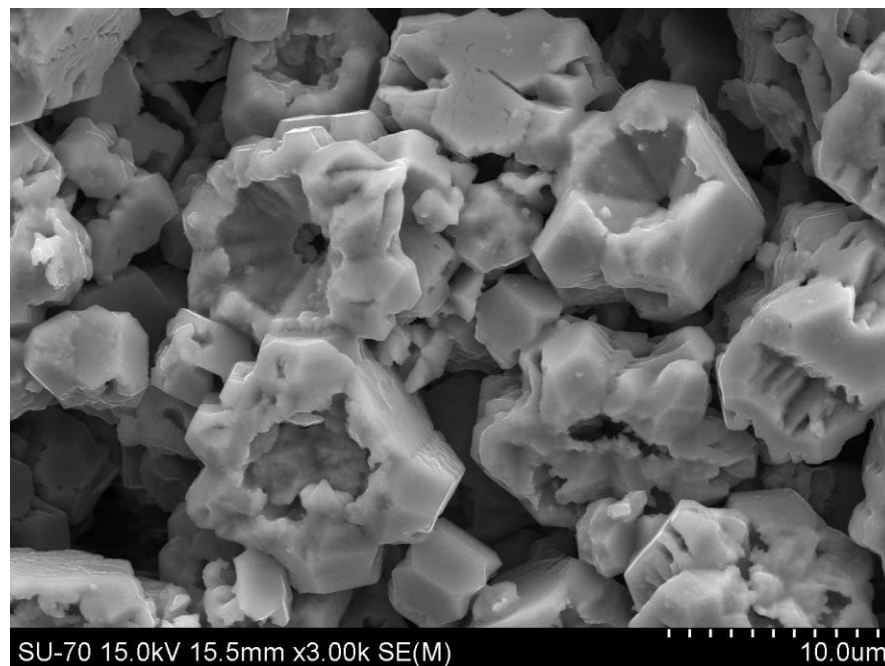
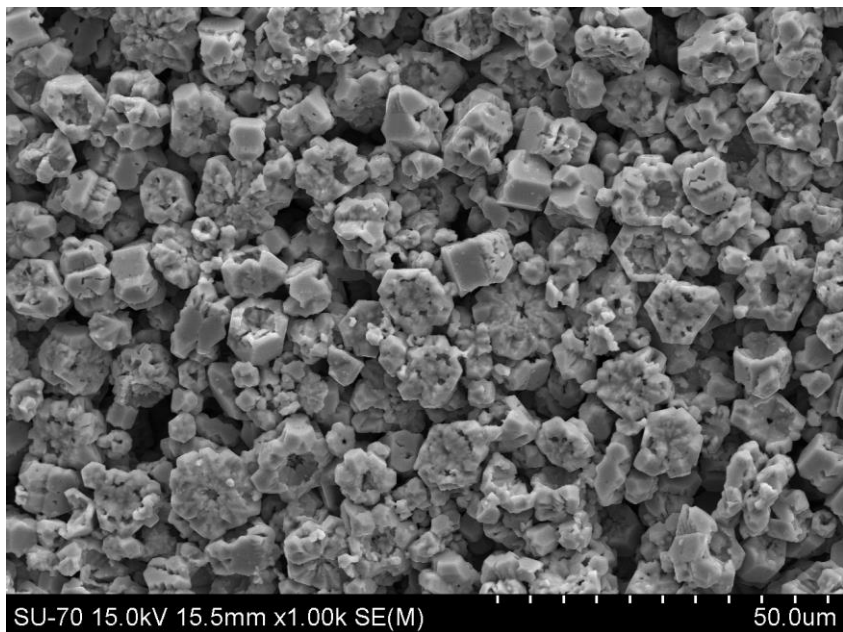
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10.1016/j.jconrel.2017.03.026

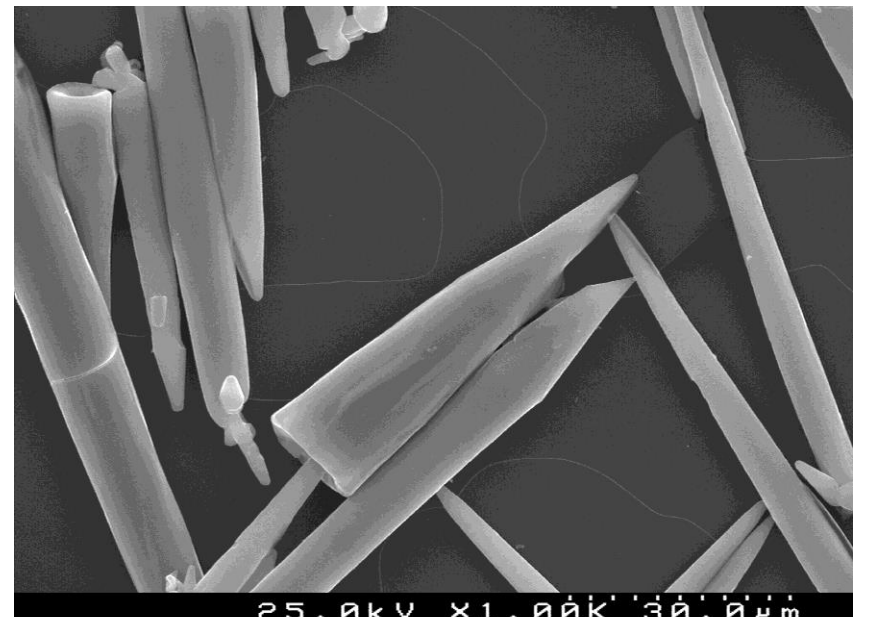
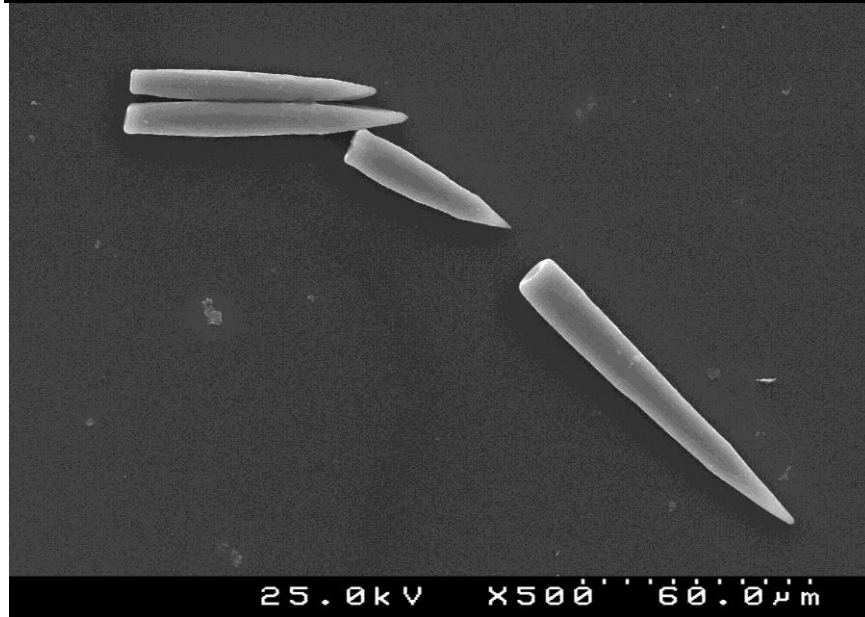
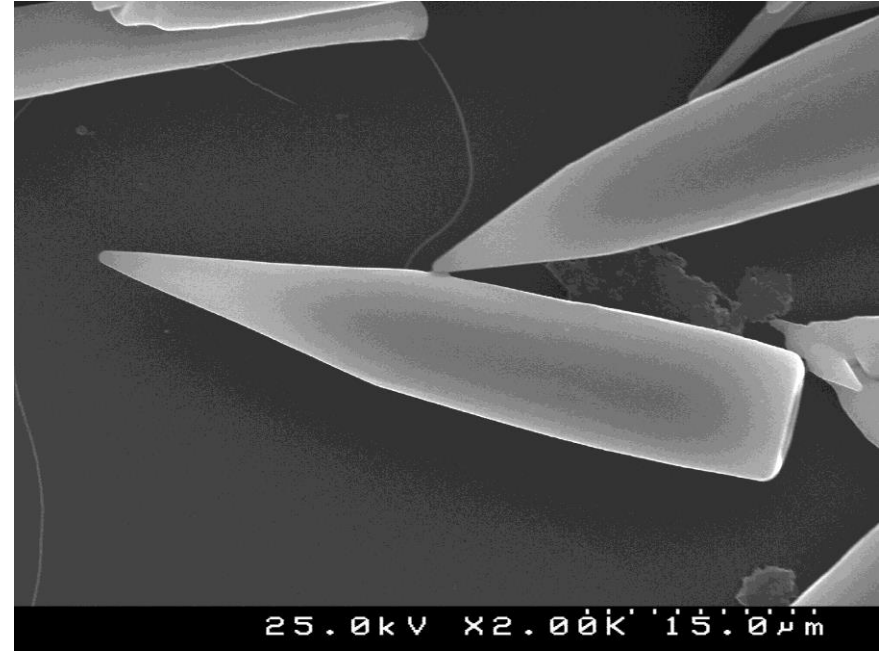
The exotic shapes



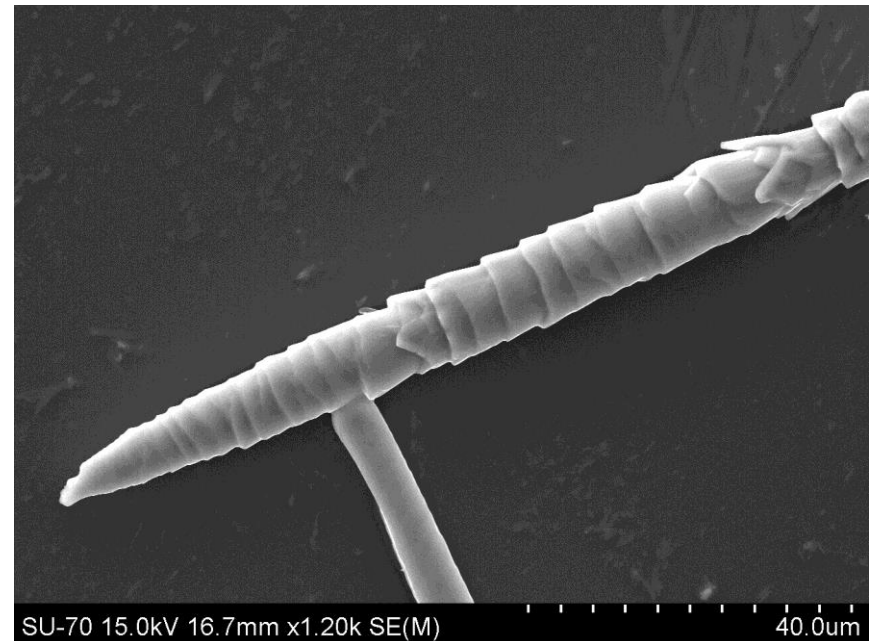
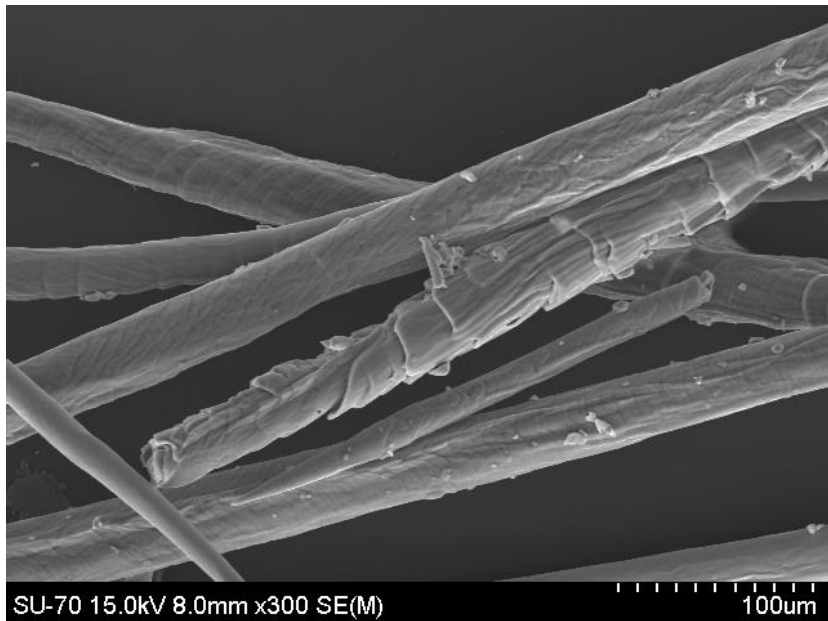
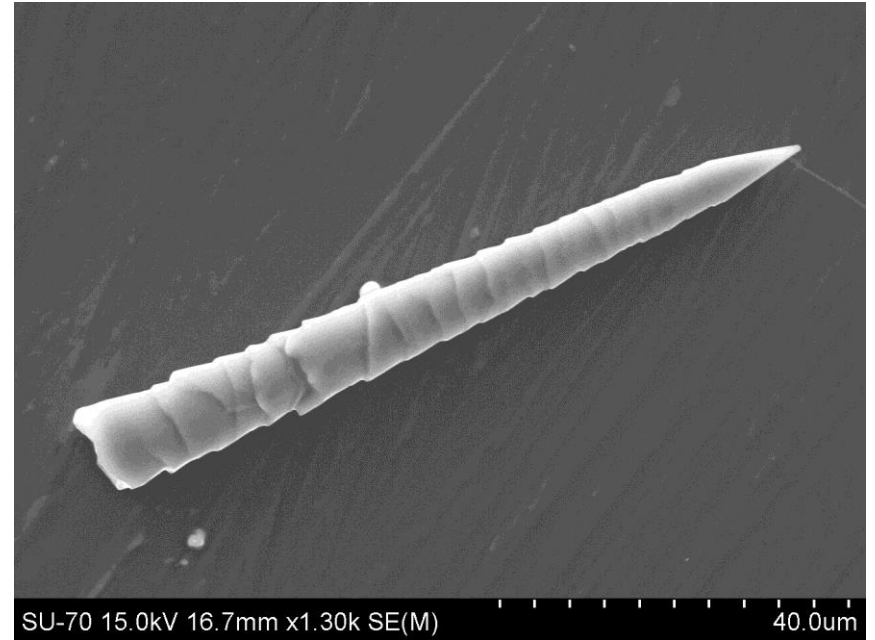
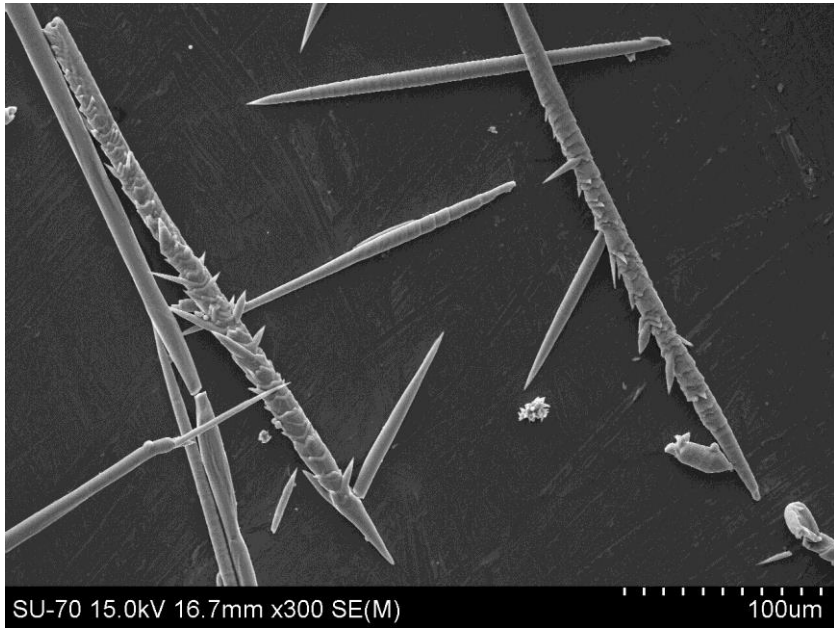
The exotic shapes



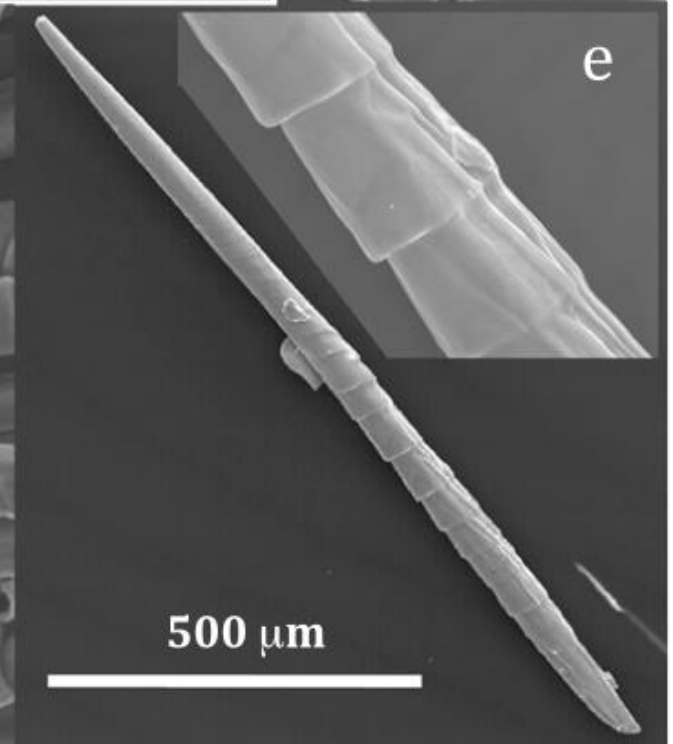
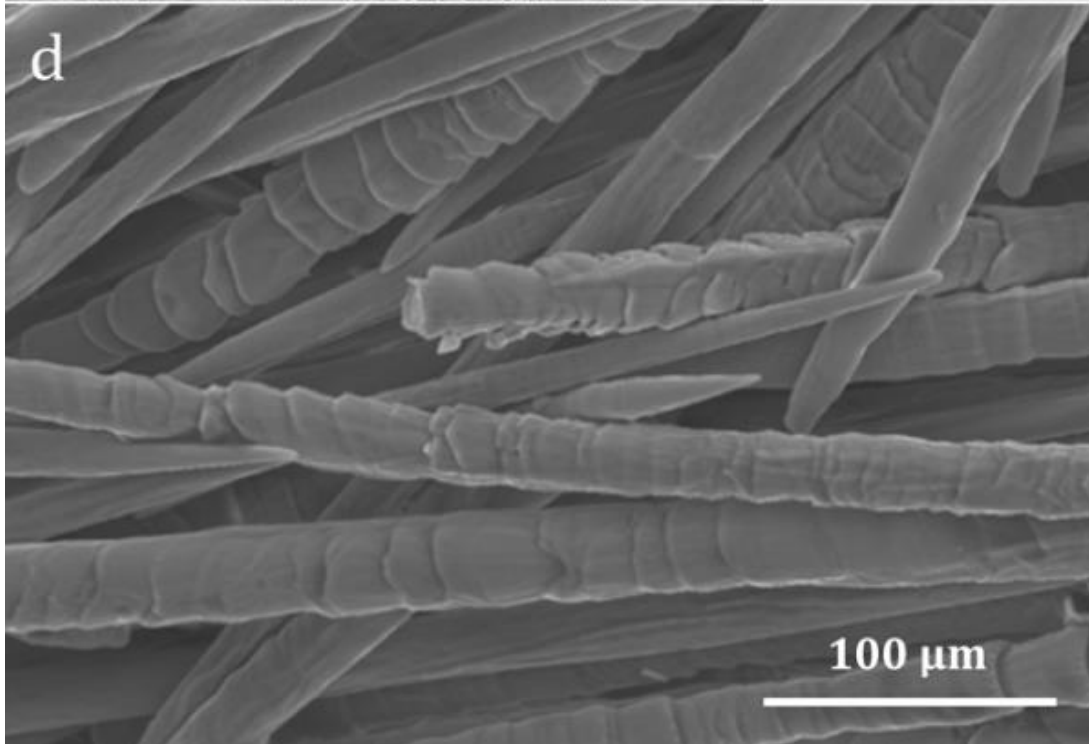
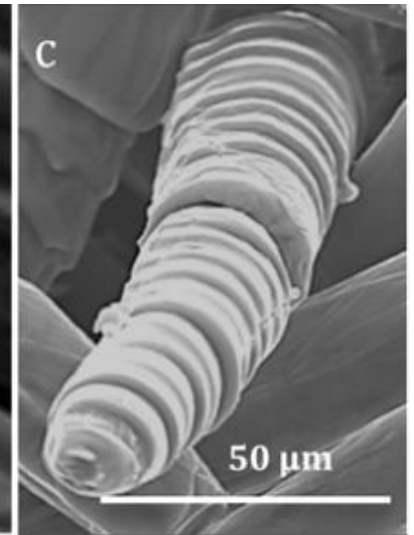
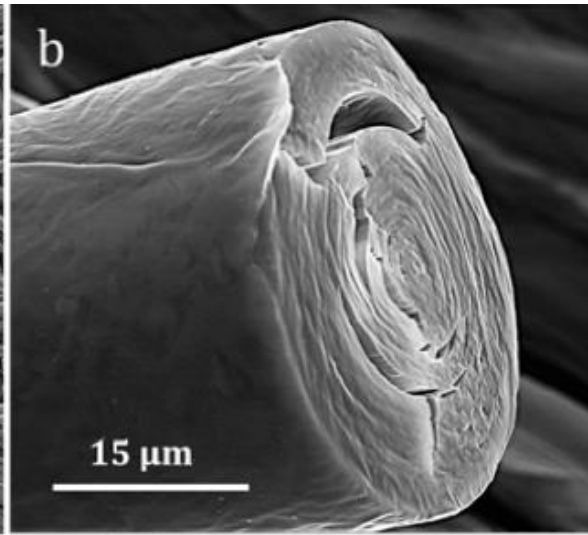
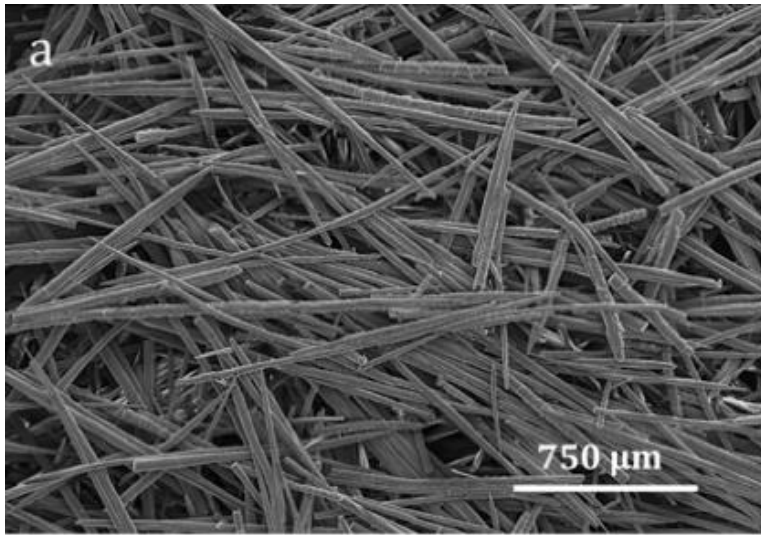
The exotic shapes without inversion symmetry



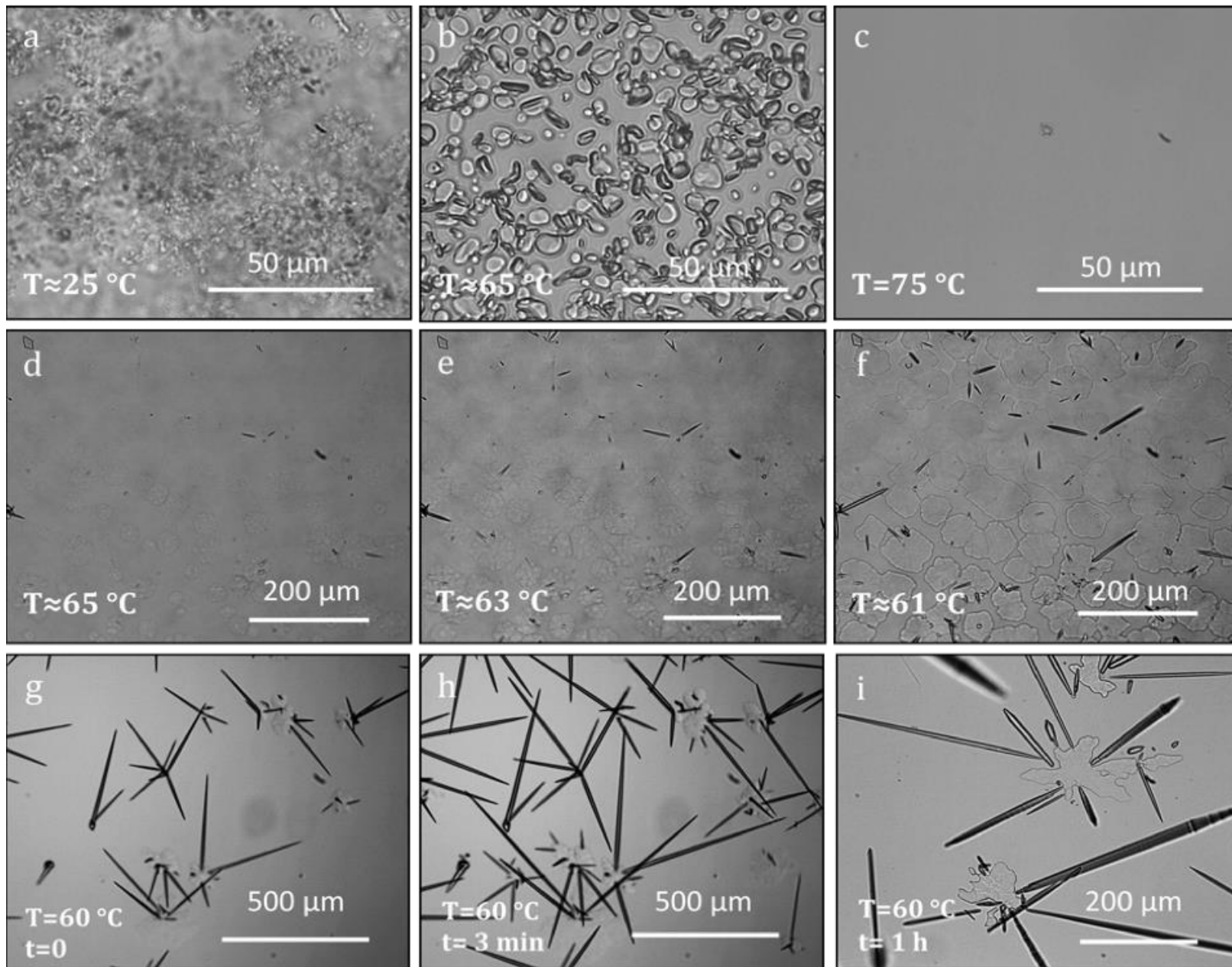
The exotic shapes without inversion symmetry



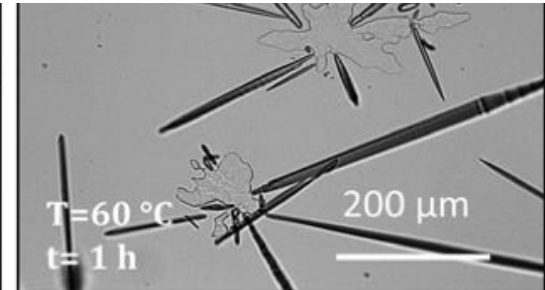
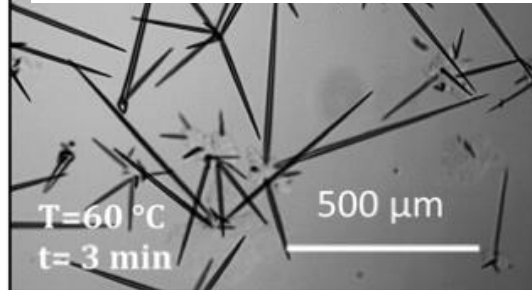
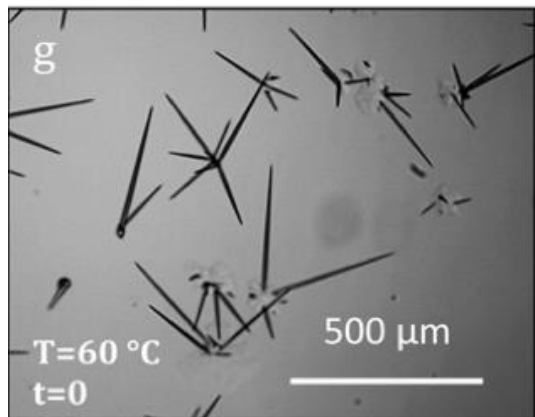
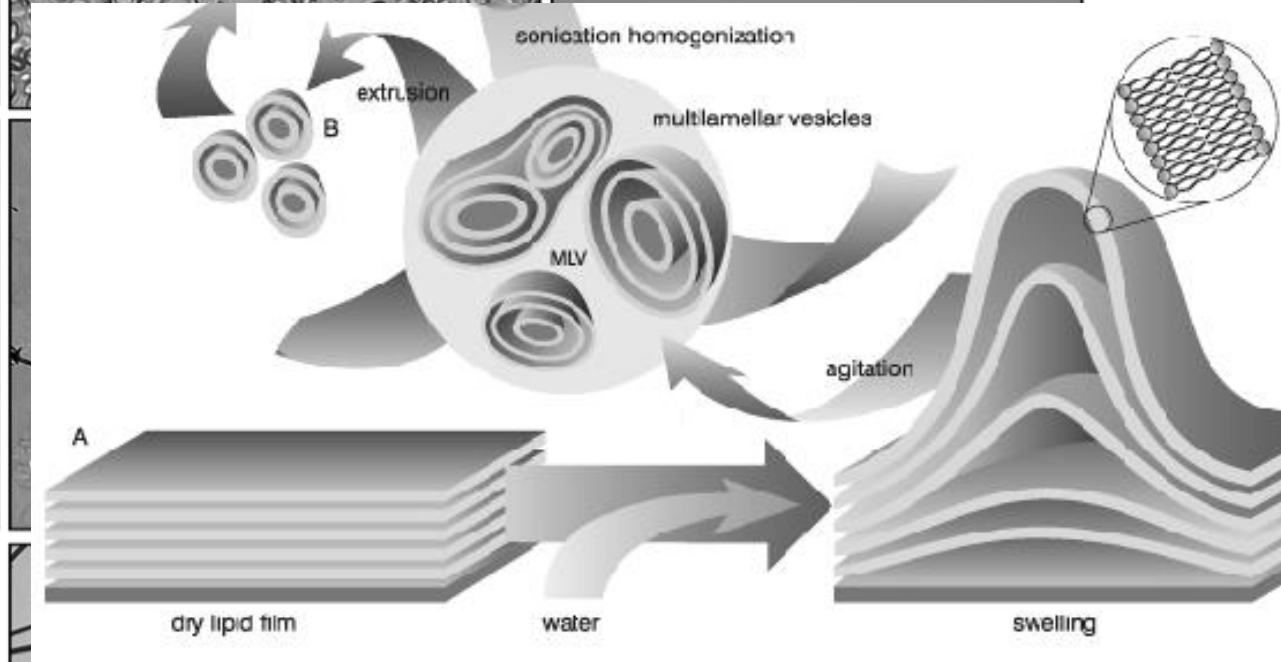
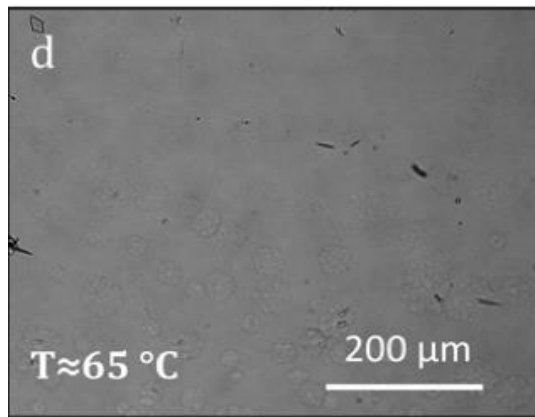
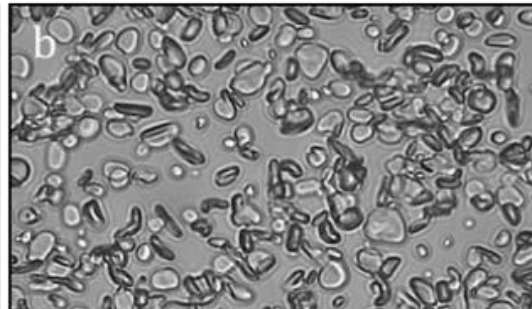
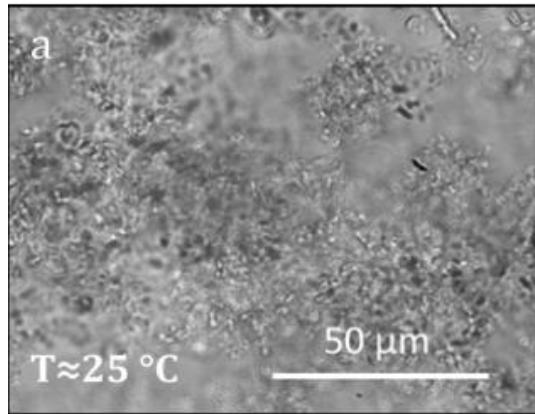
The hybrid harpoons

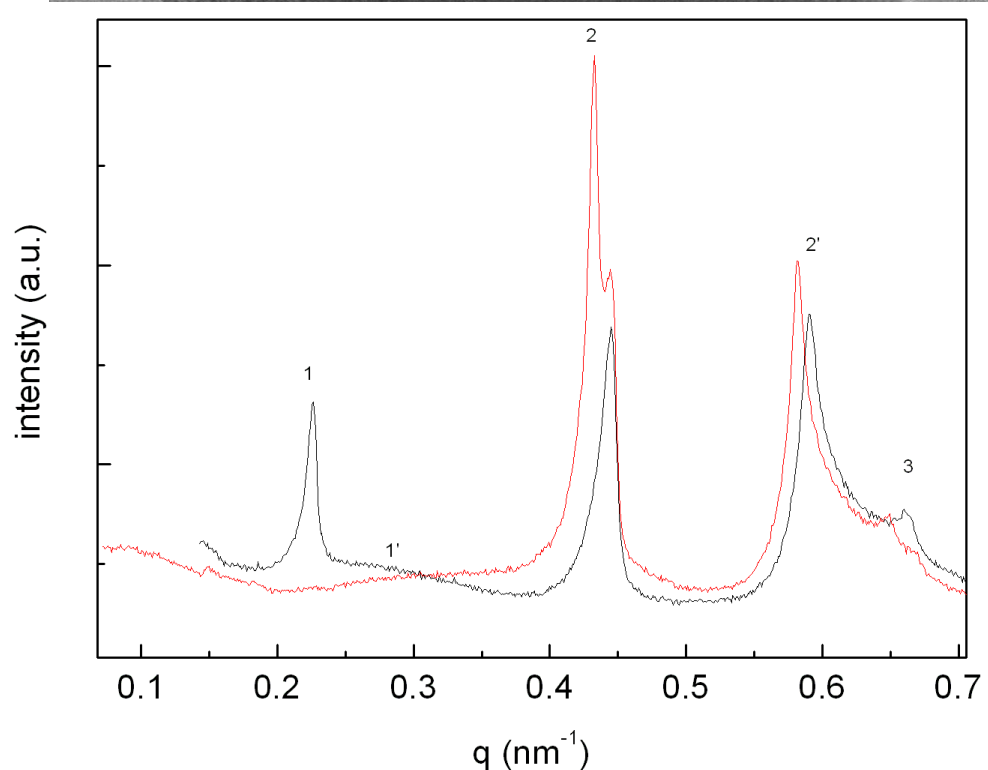
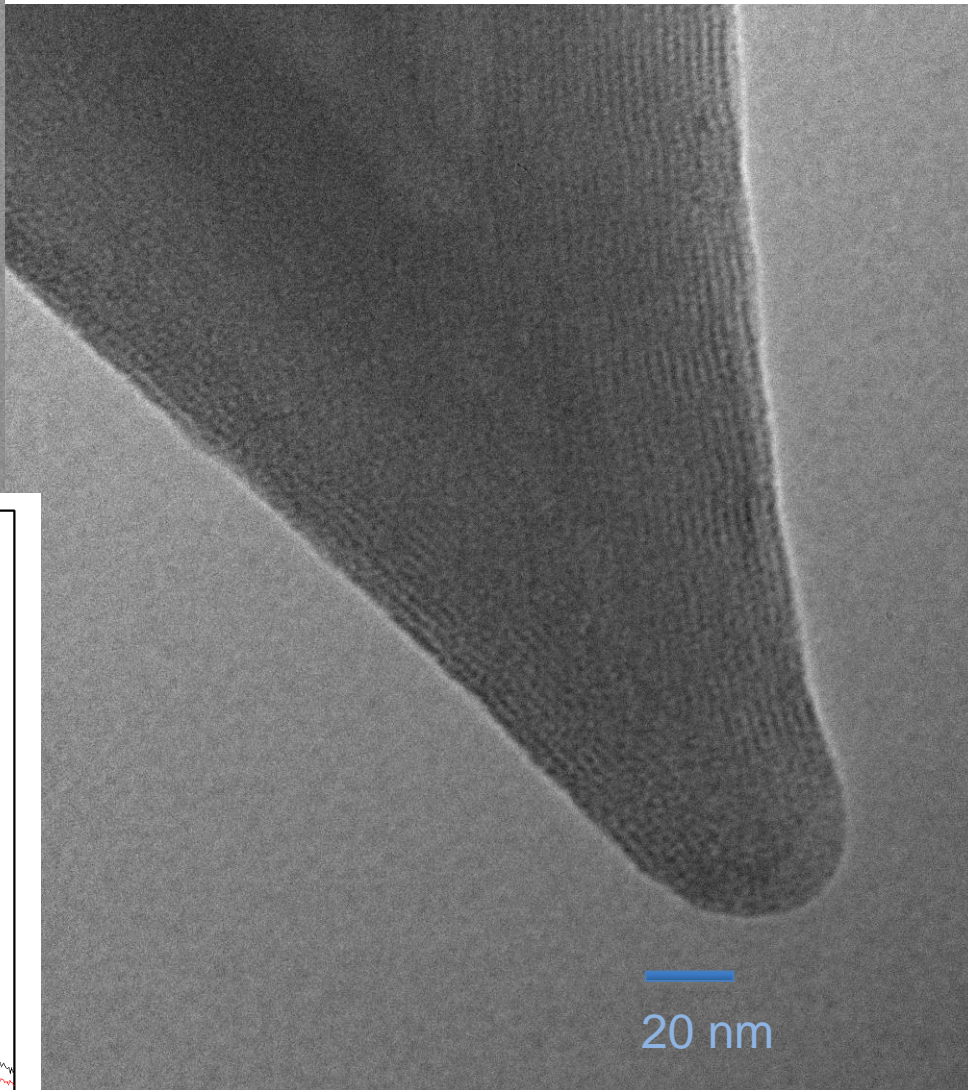
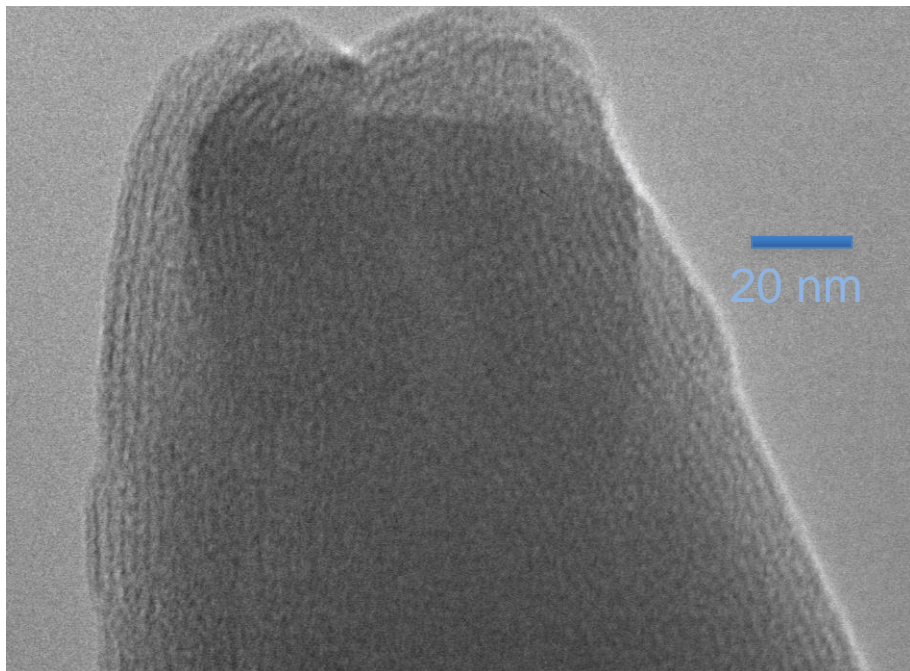


Formation of the hybrid harpoons

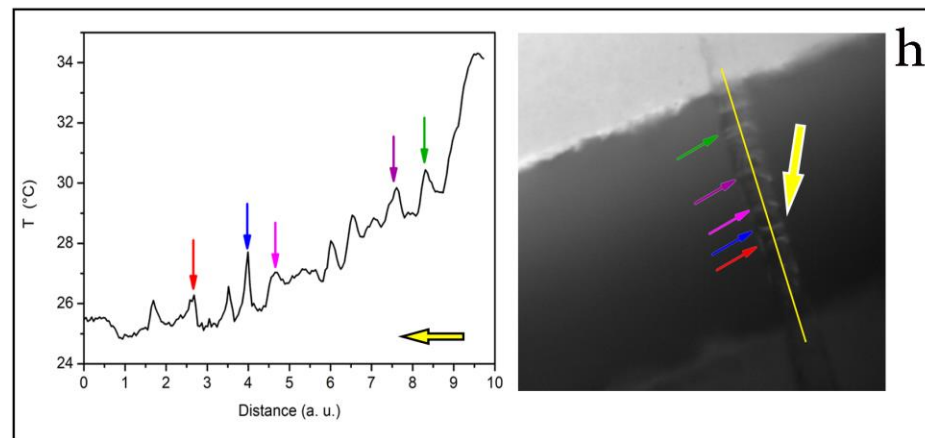
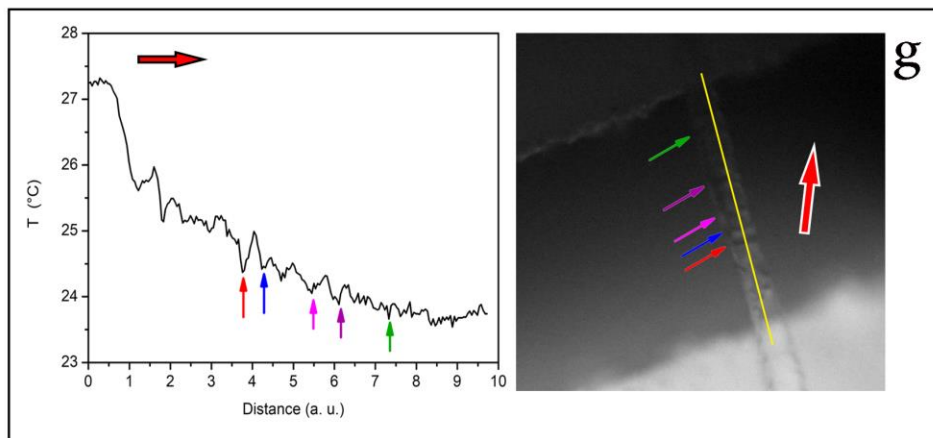
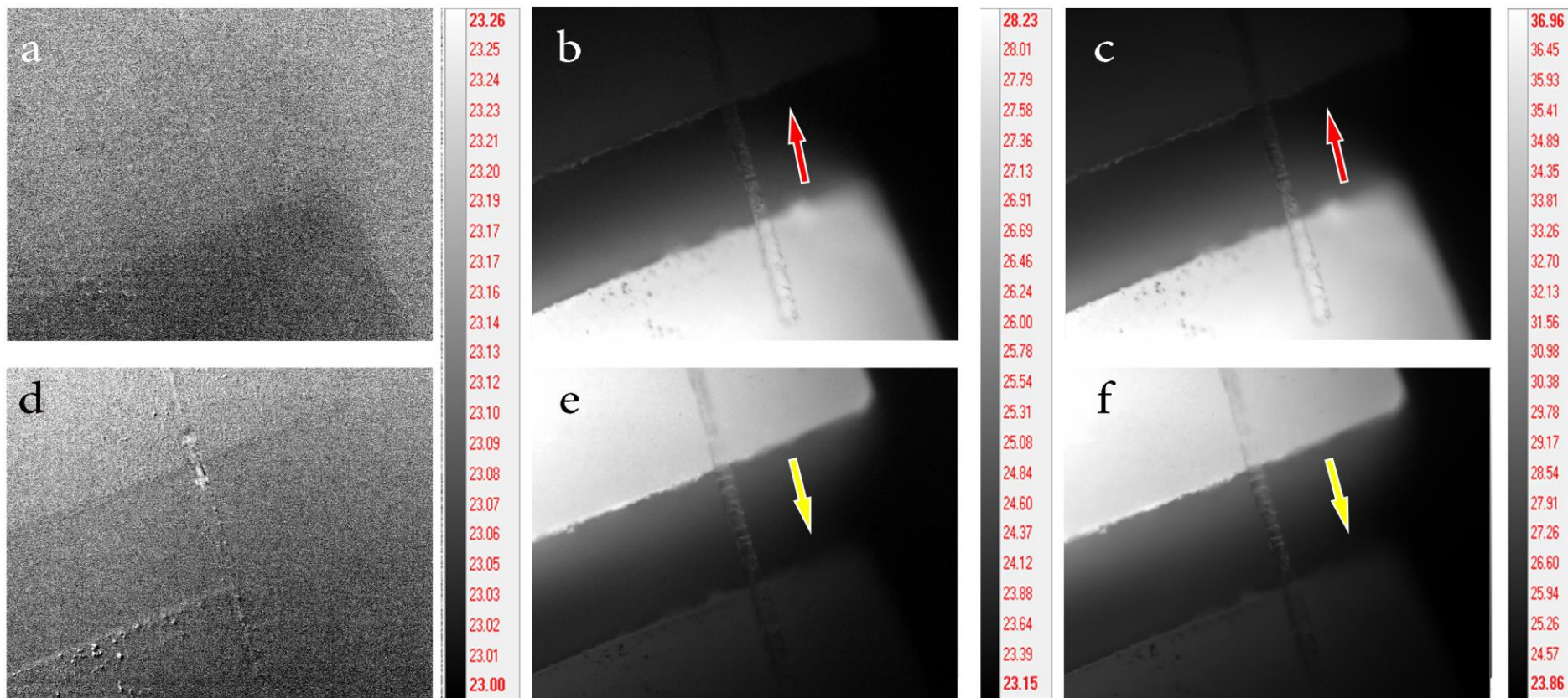


Formation of the hybrid harpoons

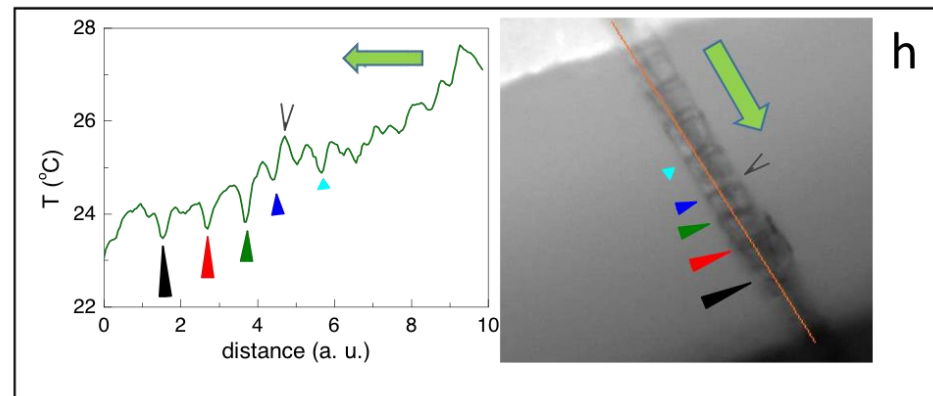
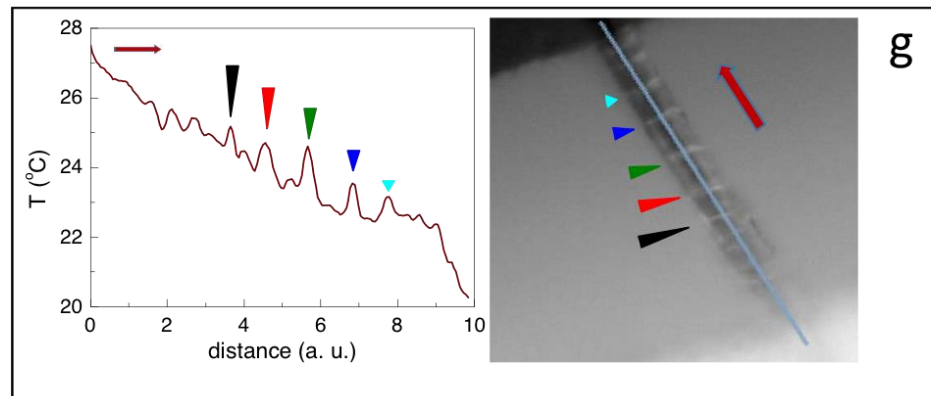
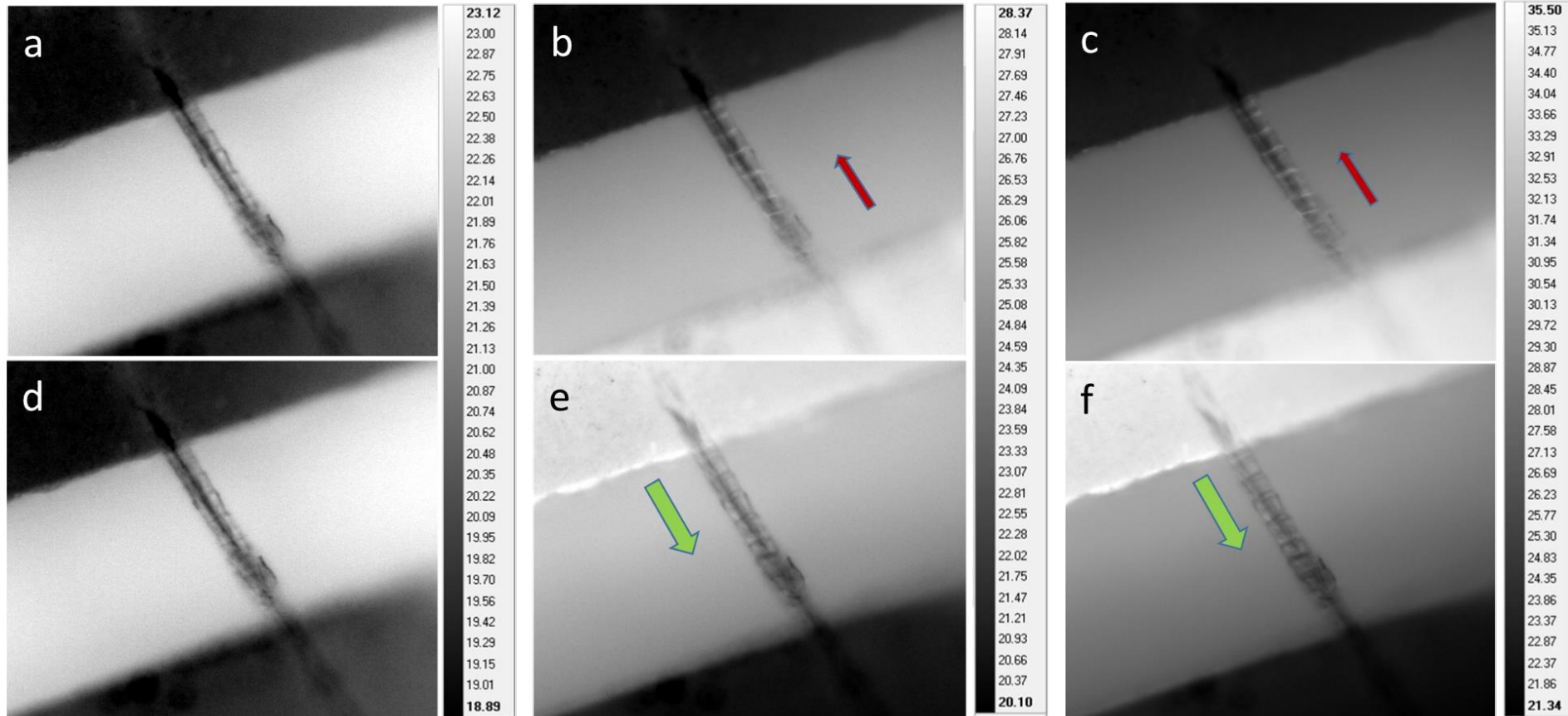




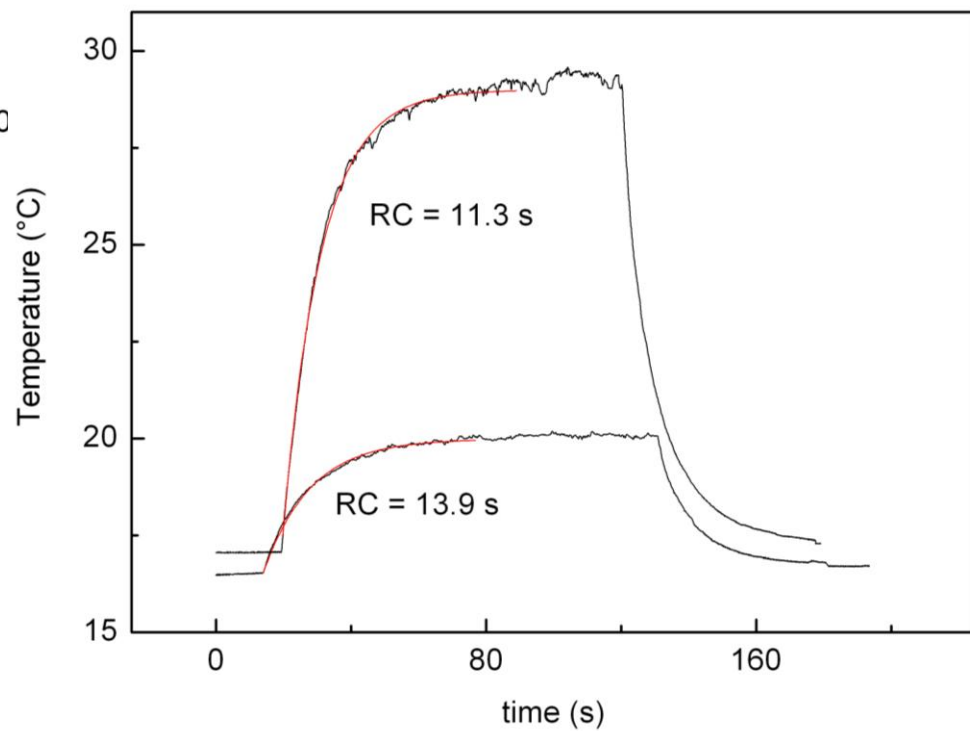
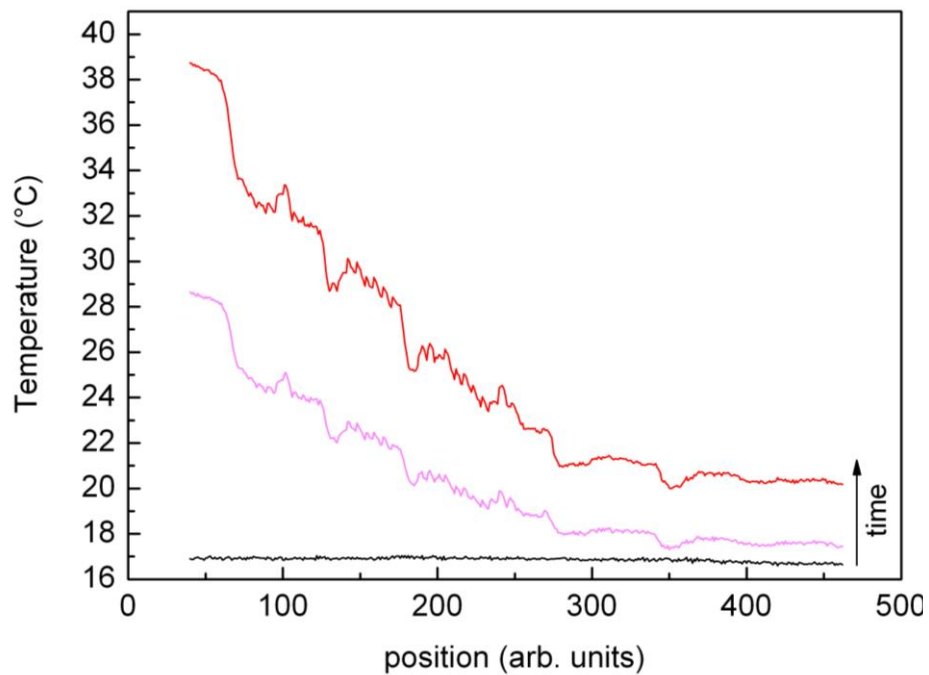
Thermal measurements



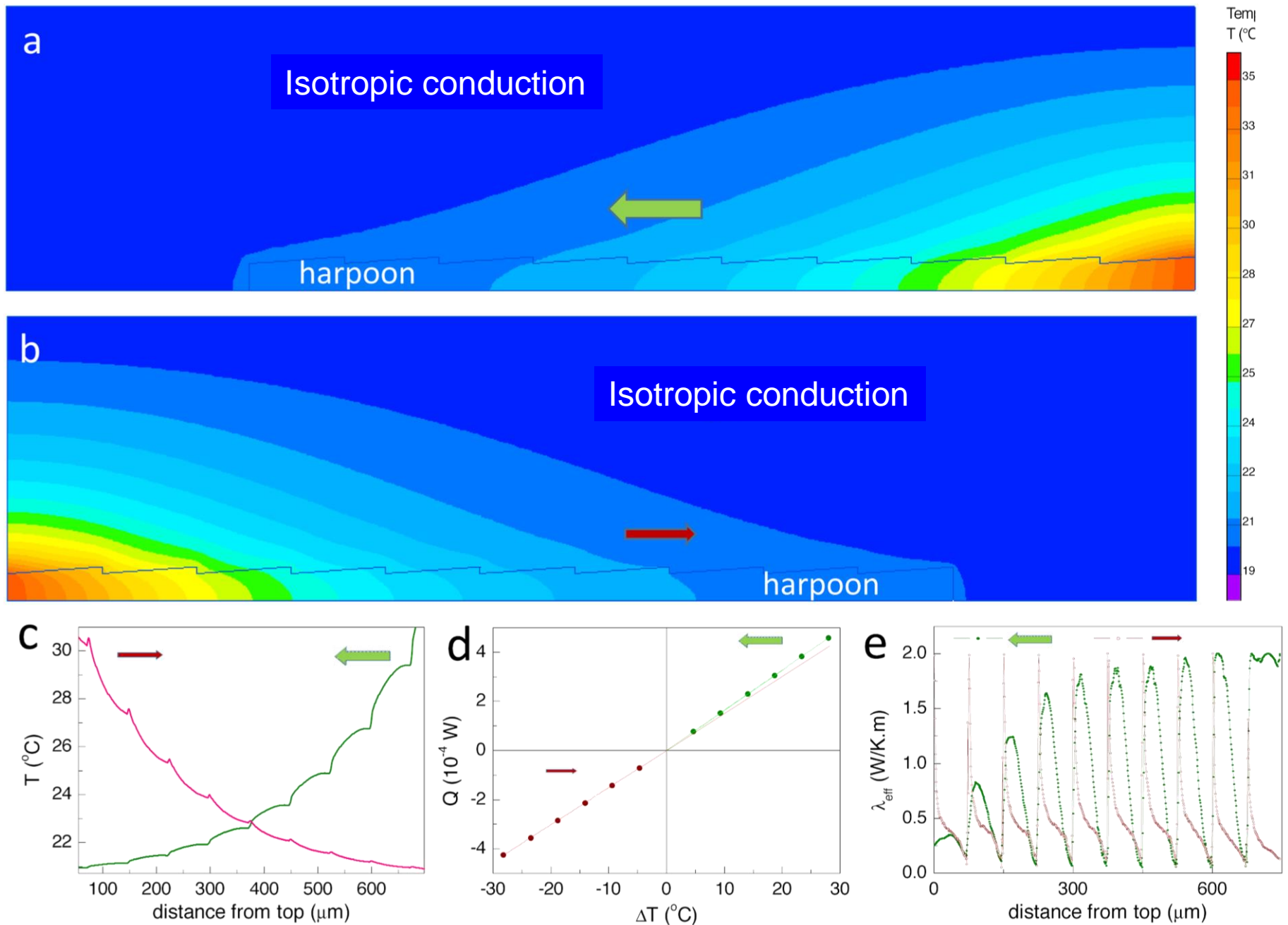
Thermal measurements



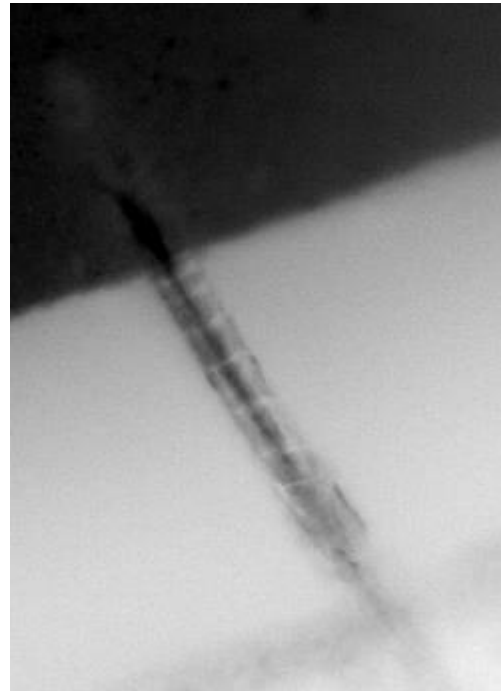
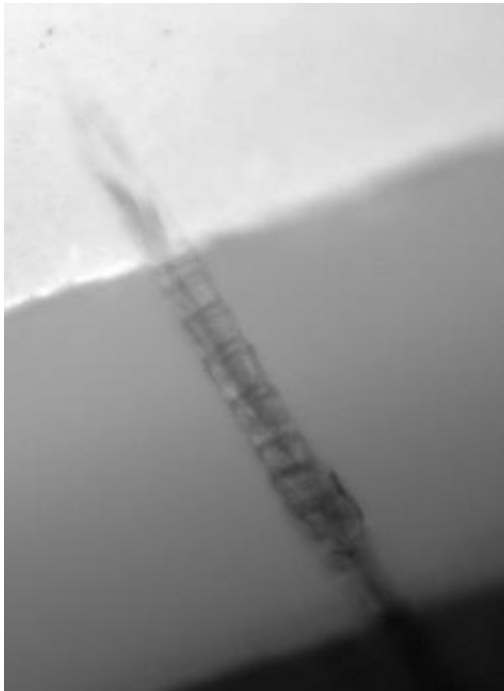
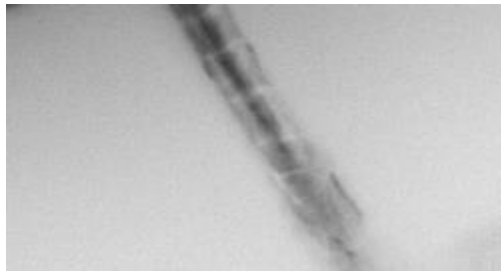
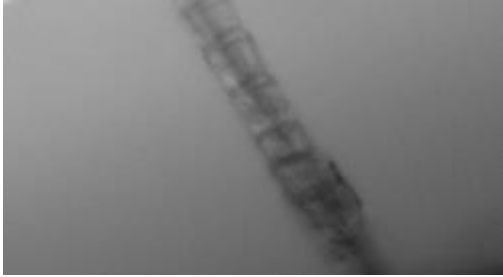
Thermal measurements: time dependence



A crude model



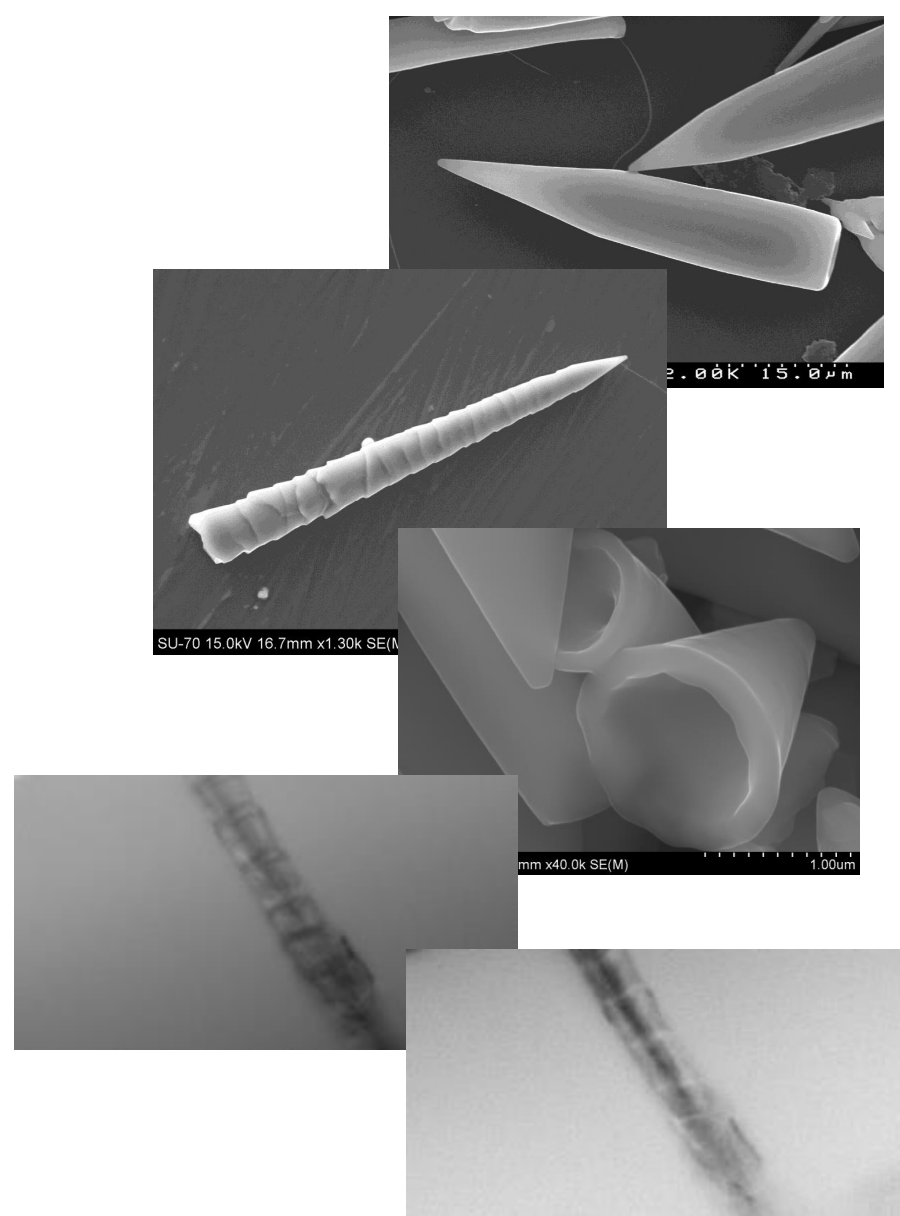
Rings as a temperature comparator...



In summary...

Unique morphologies

Anisotropic thermal transport



Thank you!

Portuguese Foundation for Science and Technology FCT:
IF 00222 2015 | IF 01533 2015
P2020 PTDC-QEQ-QIN-5975-2014
POCI-01-0145-FEDER-007679
FCT UID /CTM /50011/2013



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We acknowledge Vladimir Podnos and Tera Analysis for providing us a Quick Field Professional Edition

