

Breaking Nano-Spaghetti: Bending and Fracture Tests of Nanofibers

Tomas P. Corrales^{1,2}, Kathrin Friedemann¹, Regina Fuchs¹, Clément Roy^{1,3}, Daniel Crespy^{1,4}, and Michael Kappl^{1*}

¹Physics at Interfaces, Max Planck Institute for Polymer Research, Mainz, Germany,

²Physics Department, Universidad Técnica Federico Santa María, Valparaíso, Chile

³Graduate School of Engineering, University of Nantes, Nantes, France

⁴Vidyasirimedhi Institute of Science and Technology (VISTEC), Rayong, Thailand

*kappl@mpip-mainz.mpg.de

Nanofibers composed of silica nanoparticles, used as structural building blocks, and polystyrene nanoparticles introduced as sacrificial material were fabricated by bicolloidal electrospinning [1]. During fiber calcination, sacrificial particles are combusted leaving voids with controlled average sizes. Mechanical properties of the sintered silica fibers with voids were studied by suspending nanofibers over a gap and performing three-point bending experiments by atomic force microscopy. We investigated three different cases: fibers without voids and with 60 or 260 nm voids, elucidating how the introduction of the voids can be used to control the mechanical stiffness and fracture properties of the fibers. Fibers without voids break mainly at a single fracture point (70% of cases), while the remaining cases (30%) fracture at multiple points, leaving a gap in the suspended fiber. On the other hand, fibers with 60 nm voids fracture predominantly at multiple points (75%). Finally, fibers with 260 nm voids fracture roughly in equal proportions leaving two and multiple pieces (46% vs 54%, respectively). This fracture behaviour was compared to that of macroscopic brittle fibers (i.e. spaghetti) with predefined defects. The present study is a prerequisite for processes involving the controlled sectioning of nanofibers to yield anisometric particles [2].

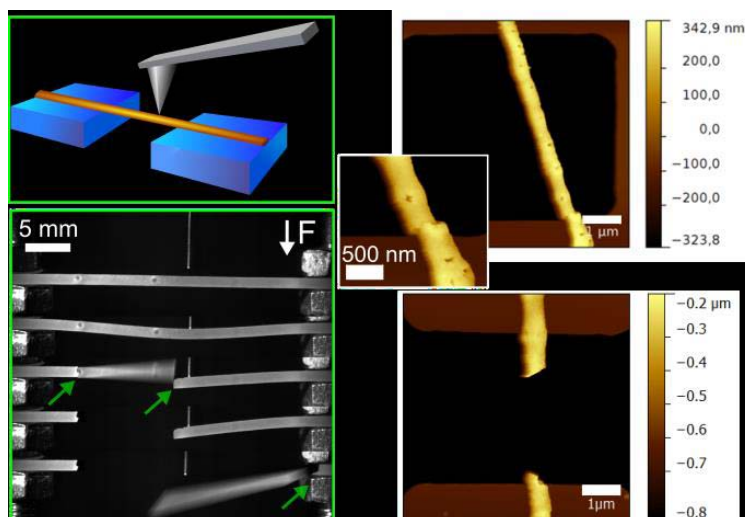


Figure1: upper left: schematic of bending test. Upper and lower right: fracture of supported nanofibers with defined defects (voids). Lower right: fracture behaviour of macroscopic spaghetti with predefined defects.

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[1] K. Friedemann, T.P. Corrales, M. Kappl and D. Crespy, *Small*, 2012, **8**, 144.

[2] T.P. Corrales, K. Friedemann, R. Fuchs, C. Roy, D. Crespy and M. Kappl, *Langmuir*, 2016, **32**, 1389.