Microtubular NEMS for on- and off-chip biosensing and -medical applications

Oliver G. Schmidt

Institute for Integrative Nanosciences, IFW Dresden
Material Systems for Nanoelectronics, Chemnitz University of Technology, Germany.

o.schmidt@ifw-dresden.de

Nanomembranes are thin, flexible, transferable and can be shaped into 3D microtubular NEMS architectures. This makes them attractive for a broad range of applications and scientific research fields ranging from novel hybrid heterostructure devices to ultra-compact 3D systems both on and off the chip. If nanomembranes are differentially strained they deform themselves and roll-up into microtubular structures upon release from their mother substrate. Rolled-up nanomembranes can be exploited to rigorously compact electronic circuitry into microtubular NEMS[1]. As rolled-up microtubes can be easily tuned into the size range of single cells, they are perfectly suited to study single cell behaviour in ultra-sensitive yet fully integrative lab-in-a-tube systems[2,3]. As off-chip components they address exciting environmental and biomedical applications. For instance, if magnetic tubes or helices are combined with spermatozoa, such hybrid micro-biorobotic motors offer new perspectives towards assisted reproduction technologies and drug delivery protocols[4-6]. However, while such micrometer sized robots offer great opportunities towards medical applications they face equally big challenges when considering *in-vivo* implementation[7].

References

1. D. Karnaushenko, N. Münzenrieder, D. D. Karnaushenko, B. Koch, A. K. Meyer, S. Baunack, L. Petti, G. Tröster, D. Makarov, O. G. Schmidt, *Adv. Mater*. **27**, 6797 (2015)
2. C. S. Martinez-Cisneros, S. Sanchez, W. Xi, O. G. Schmidt, *Nano Lett*. **14**, 2219 (2014)

3. M. Medina-Sánchez, B. Ibarlucea, N. Pérez, D. D. Karnaushenko, S. M. Weiz, L. Baraban, G. Cuniberti, O. G. Schmidt, *Nano Lett*. **16**, 4288 (2016)
4. V. V. Magdanz, S. Sanchez, O. G. Schmidt, *Adv. Mater*. **25**, 6581 (2013)
5. M. Medina-Sánchez, L. Schwarz, A. K. Meyer, F. Hebenstreit, O. G. Schmidt, *Nano Lett*. **16** (1), 555 (2016)
6. H. Xu, M. Medina Sanchez, V. Magdanz, L. Schwarz, F. Hebenstreit, O.G. Schmidt, arXiv:1703.08510
7. M. Medina-Sánchez, O. G. Schmidt, *Nature* **545**, 406 (2017)