Moreover, the obtained single molecule trajectories can be directly compared to the real structure of the mesoporous host by plotting an overlay of the trajectories and TEM images of the same area of interest (Fig.1b).[3]

The diffusion coefficient for each single molecule can be extracted from the linear part of the mean square displacement (MSD) plots according to the Einstein-Smoluchowski relation $< r^2 (t) > = 2dDt$, where d indicates dimensionality (Fig.1c).

Mesoporous materials can be structurally tuned to a large degree and also functionalized at the pore walls with numerous chemical functional groups. Therefore, they are able to incorporate a large variety of different guest molecules. We used mesoporous filaments as carriers for fluorescently labeled ss- and ds-DNA. Förster-Resonance-Energy-Transfer (FRET) measurements showed that the DNA is still intact inside the mesopores. Moreover, we were able to observe DNA diffusion inside the mesopores of the filaments. In another approach, mesoporous silica nano-particles were used as drug-delivery devices for controlled colchicine release into HuH7 cells.[4,5] After about 2h, the microtubules were depolymerized and finally the cell morphology was completely disintegrated (Fig.2).

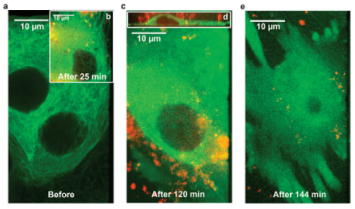

Figure 2: Drug delivery by colchicine loaded silica nanoparticles to HuH7 liver cancer cells. a) Untreated HuH7 cells with a GFP-labeled well-structured microtubule network (green). b) HuH7 cells were exposed to colchicine-loaded silica nanoparticles for 25 min. The microtubule network still appears to be intact. c) After 120 min, the microtubule network disappeared and a diffuse fluorescence due to microtubule depolymerization was observed. d) Side view of the HuH7 cell represented in panel c, where the internalized nanoparticles (yellow) are visible. Several other nanoparticles (red) are on the top of the cell. e) After 144 min the cell morphology was disintegrated, confirming cell death.

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