CHYN MEETS HARBOR

Network Properties of Silver-Nanowire Composites – Experiment and Theory

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From CVD to ALD in ultra high aspect ratio channel systems – and how to make suspended nanochannels the unconvential way

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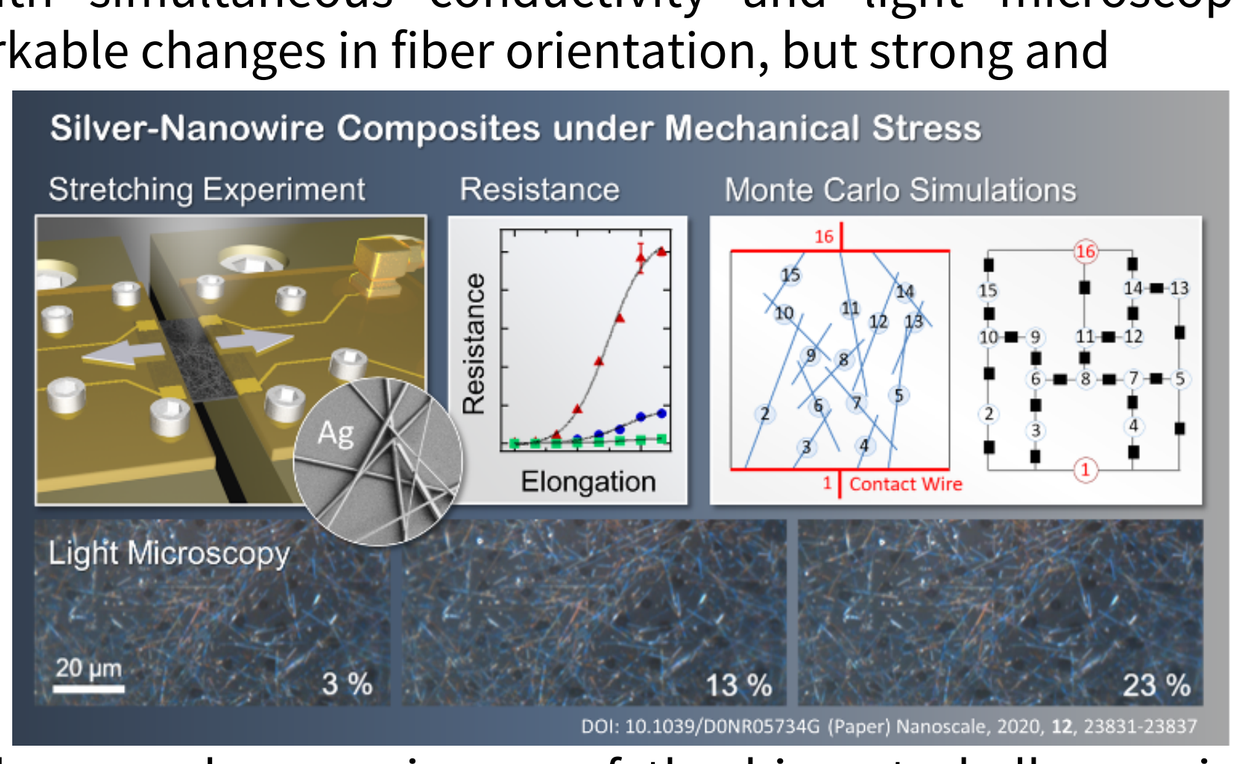
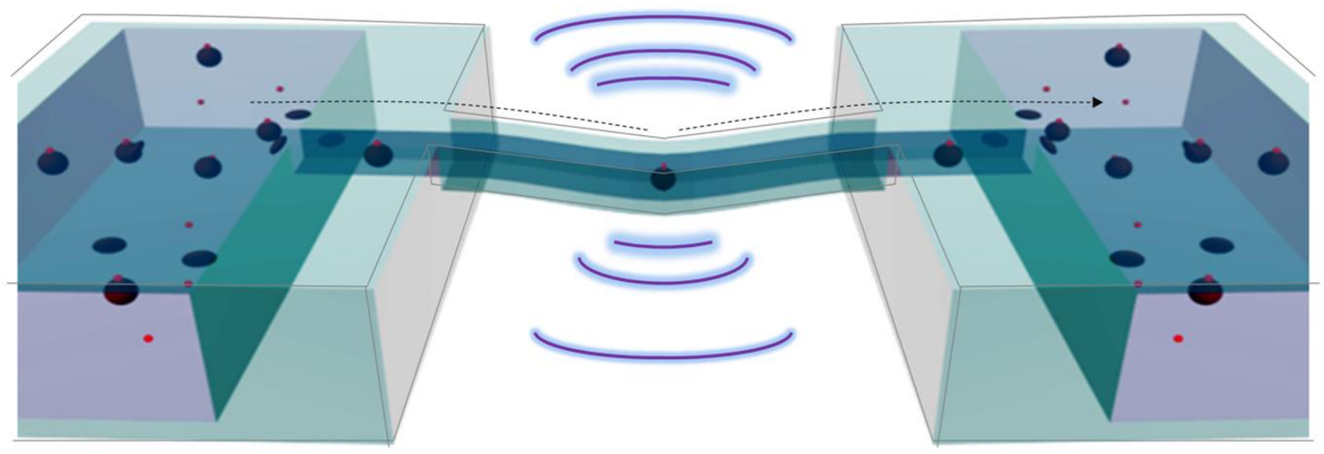
Abstract Talk 1: Metal nanowire-polymer composites are promising candidates for (3D)-printable flexible electronics. Silver-nanowire networks have proven to be a suitable conductive filler due to their excellent conductivity and transparency. Low percolation thresholds and 2D network properties are achieved even with a small amount of material due to the high aspect ratio of the used nanowires. By drop casting of a silver-nanowire suspension, 2D networks of randomly oriented and located nanowires can easily be produced. The embedding of the 2D nanowire networks in a polymer matrix leads to highly conductive and thin composite layers. A 3D printable polymer matrix enables functional additive manufacturing of these materials. Here, we report on mechanical stress tests of silver-nanowire composite samples with simultaneous conductivity and light microscopy measurements. We found isotropic networks and no remarkable changes in fiber orientation, but strong and reversible changes in network resistance as a function of strain. We model the strain-resistance behavior of the silver-nanowire composites based on the local force distribution within the polymer matrix and the tunneling resistance between the nanowires by a Monte Carlo method. By this, a physical model based on the experimental results is presented offering a deep understanding of network properties within nanowire composites for flexible electronic applications.



Abstract Talk 2: Measuring the mass of single molecules, one by one, is one of the biggest challenges in biomedical technology. It would allow to identify and quantify a variety of biomarkers, for example, for early disease detection. In our ERC project FLUINEMS, we work towards detecting and weighting single molecules in their natural environment: in solution. For this, we want to use a hollow nano-resonator as a nanochannel, which is suspended and free to resonate in vacuum, while the liquid and the molecules flow inside. In this configuration, the channel size and mass should be in the range of that of the molecules, to maximize the sensitivity. But the challenges for making such devices with very light, suspended nanochannels are huge. Combining our experience in nanoimprint lithography and a newly developed methodology for flow-through atomic layer deposition (ALD), we were able to fabricate the first hybrid organic-inorganic channel systems. In the talk, we will show the capabilities of the in- house developed ALD system and the first set of suspended nanochannels.



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