Initial Design and Nanofabrication of Energetically Efficient Biologically Motivated Contacts

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The motivation for the introduction of biologically motivated contacts and interconnects is presented. This is followed by the examples of early development of mesowires and contacts that follow modified and simplified biological patterns that can serve as initial test patterns for the future implementation of the biologically motivated contacts in nanoelectronics.

Development of novel contact geometries is potentially critical step in developing novel interconnects for semiconductor industry, especially from the standpoint of the energy efficiency. In an effort to move away from conventional contact geometries and patterns, we sought the motivation in biological contacts. To this end, we compare various biomechanical contacts, such as ones by insects, as well as the physiological contacts between dissimilar organs and tissues. Based on these broadly defined biocontacts, we developed simplified novel contact geometries, which can be patterned with a standard (either optical or e-beam) lithography and etching and deposition techniques.

The initial considerations in our contact design revolves around two issues, which we propose as the hypotheses worth testing and future criteria for the quality control of the novel mesoscopic and nanoscale contacts.

1. There is a correlation between the magnitude of the stress and/or strain (depending on the design and nanofabrication details) and the power loss in the contacts to meso-/nanowires, and
2. There is a correlation between the broadband noise power and the power loss in the contacts/nanowires, dictated in part, by the quality of the nanofabrication and growth processes that lead to the formation of the meso-/nanocontact.

After fabrication, we show how do the I-V curves and other transport characteristics differ between standard top-down (or bottom-up) “rectangular” and novel bio-motivated contacts. Among other preliminary finding, we see how the noise characteristics of these contacts have different power spectrum, and we compare the role the defects play in transport efficiency.

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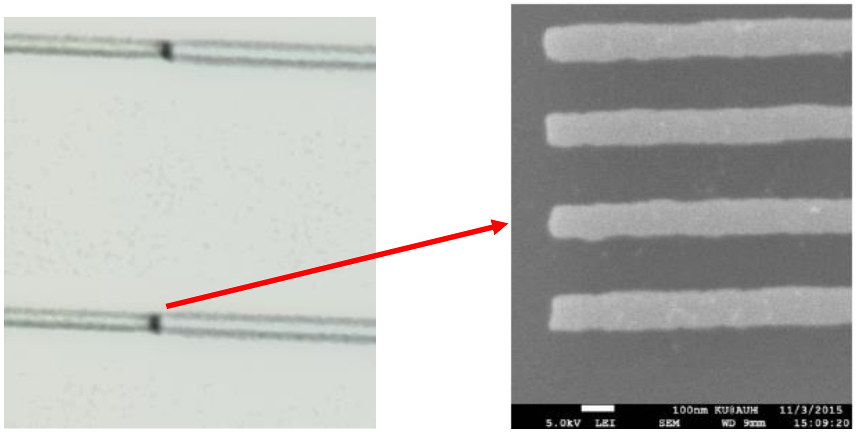

Figures: (left) optical microscope image of the end contact tapering-like process of developing end contact geometry to a bundle of nanowires (two bundles are shown in the image); (right) SEM image of several mesoscopic wavy-pattern nanowires within the bundle .