

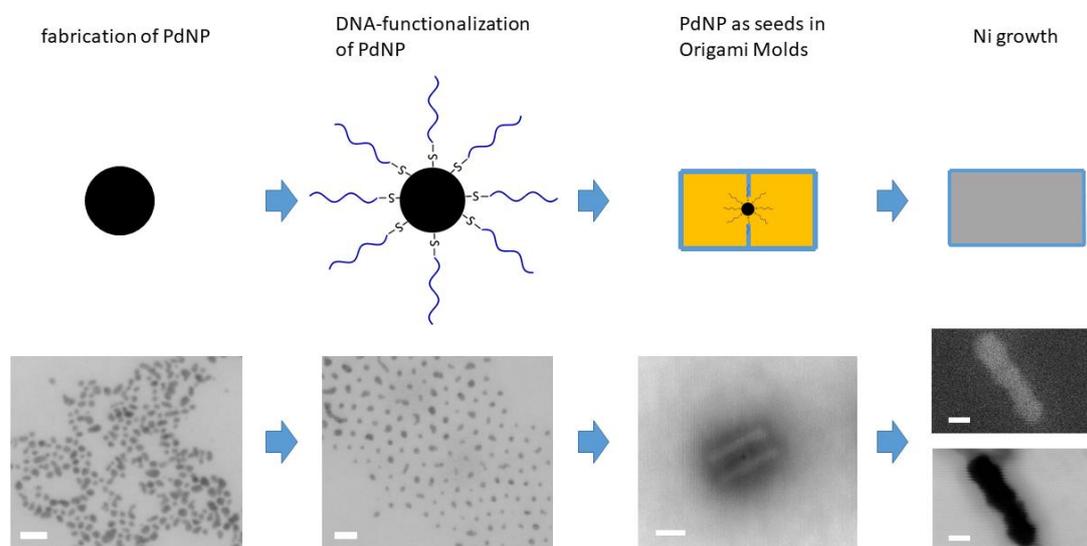
## Synthesis of nickel nanoparticles using DNA Origami molds

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A challenge for the bottom-up fabrication of nanoelectronic devices is the accurate material deposition on the nanometer scale. Concerning biomolecular materials, DNA nanotechnology meets this challenge by being highly precise at building DNA structures of nearly any desired form. We recently introduced the concept of a DNA origami mold-based particle synthesis that allows the synthesis of inorganic nanoparticles with programmable shape. Particularly, we demonstrated the fabrication of 40 nm long rod-like gold particles with quadratic cross-section [1] as uniform micrometer-long conductive gold nanowires of 20-30 nm diameter [2]. Direct conductance measurements demonstrated the metallic conductivity of these wires.

Here, we expand the mold-based fabrication method to nickel, being a ferromagnetic material. To allow a seeded-growth of nickel inside the origami molds, palladium nucleation centers needed to be introduced into the mold cavity. We therefore synthesized palladium nanoparticles and established an efficient functionalization protocol of the particles with single-stranded DNA. The functionalized particles were bound to complementary DNA strands inside the mold cavity from which a seeded nickel deposition was initiated. This provided rod-like nickel nanoparticles with an average diameter of 25 nm. The introduction of magnetic domains in the mold-based fabrication scheme provides a possible route to establish nanoscopic spin-valve structures.



**Figure 1.** Scheme and tSEM images illustrating the mold-based synthesis procedure of nickel nanostructures. Palladium nanoparticles were synthesized, functionalized with single stranded DNA and placed inside DNA origami molds. These particles were used as a nucleation center for a seeded nickel growth while the origami shell confined the resulting structure. Scale bar: 20nm.

[1] S. Helmi et al. *Nano Letters*. **14** (2014), 6693- 6698.

[2] T. Bayrak, S. Helmi, J. Ye, et al. *Nano letters*. **18** (2018), 2116-2123.