WATER-ASSISTED GROWTH OF NANOFLORETS HYBRID NANOSTRUCTURES AND THEIR APPLICATION IN SENSING PLATFORMS

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Self-processing (SP) is typically recognized in the context of biological systems. For example, proteins and RNA molecules undergo SP, which includes chemical and structural modifications.
Recently, we developed a new strategy for the synthesis of metal-semiconductor hybrid nanostructures relying on self-processing mechanism which yield complex hybrid nanostructures in one step by triggering a programmable cascade of events that is autonomously executed. The semiconductor-metal hybrid nanostructures obtained resemble the morphology of grass flowers, termed here Nano-floret. Interestingly, water are used during the 'growth' process of Nano-florets as a mild etchant for synthesis intiation and progression. The synthesis mechanism was directly followed by in situ and ex situ scanning transmission electron microscopy and inductively coupled plasma mass spectrometry analyses. Our results indicate that distinct processing steps including localized oxide etch and metal deposition and process termination can be identified similarly to conventional top-down processing sequences.
The Nano-floret hybrid nanostructures were used for fabrication of sensors featuring a self-forming nanojunction. A main feature of the device is a self-formed nanogap bridging between the Nanofloret (NF) hybrid nanostructures (HNS) and a macroscopic counter-electrode which enables direct detection of molecules and quantum dots, including their electronic fingerprint.

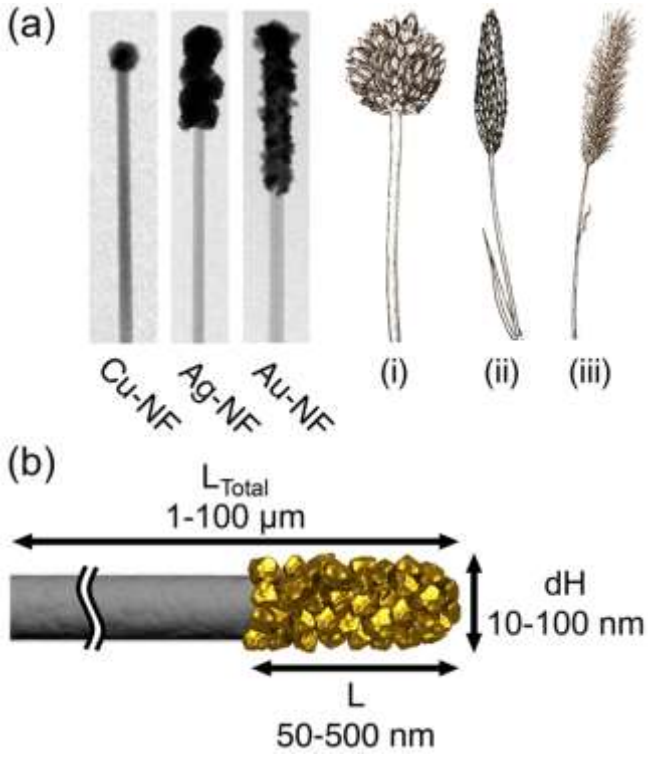

Figure 1. Transmission electron microscopy showing Nano-floret structures (a) obtained for SiGe nanowires reacted with Cu, Ag, and Au featuring a stem and corona (deposited metal) at the tip region. Illustrations of common grass flowers (florets) that resemble the Nano-floret structures obtained for the different metals are shown. (i) Allium scorodoprasum L. subsp. rotundum (L.) Stearn, (ii) Phleum subulatum (Savi) Asche rs. & Graebn., and (iii) Tetrapogon villosus Desf.
(b) Typical dimensions of the Nano-floret components; overall length of 1-100 microns resulting from the SiGe NW used, deposited metal cap is typically 10-100nm in diameter and 50-500 nm long.