# Highly Selective, Electrically Conductive Monolayer of Nanoparticles on Live Bacteria

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## ABSTRACT

**Using specific peptide bacteria affinity, a monolayer of 30 nm Au particle is selectively deposited on live bacteria surface to produce electrically conducting bridges spanning over 12 $\mu$m. The conductivity of the monolayer network is further improved by over 10-fold by "electric-field annealing". The annealing process is explained by a percolation model.**
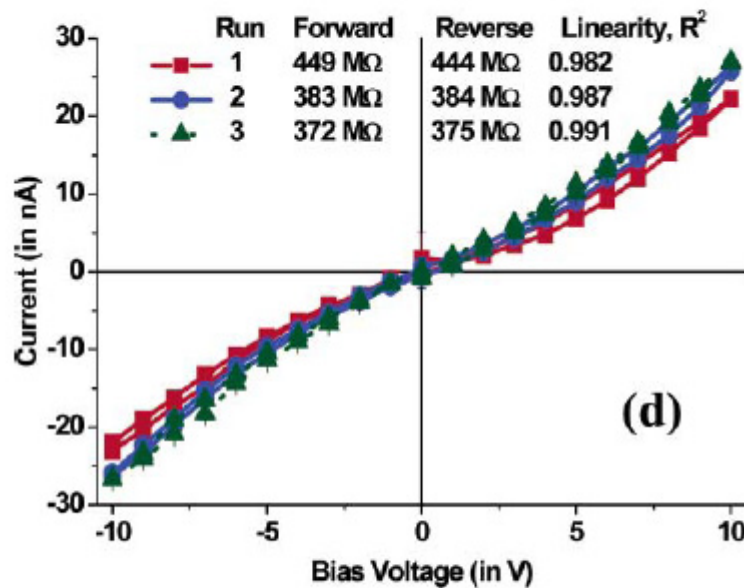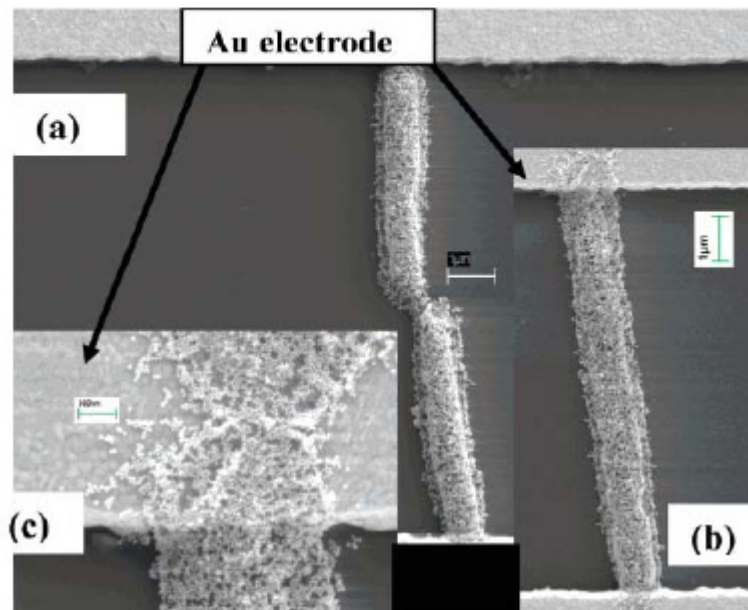
**Figure 1.** (a), (b) Typical FESEM images showing bacteria coated with Au nanoparticle monolayers and spanning between two Au electrodes at the extreme ends. The size bar is $1\mu m$. (c) The nanoparticle size and monolayer morphology are more evident at higher magnification. The size marker is 300 nm. (d) Typical $I-V$ characteristics of as-received (run #1) and subsequent cycles of a device with 15 bridges between the electrodes. The error bars on each data point are based on 10 points over a time period of 5 s. The resistance is measured by fitting a line through the origin with fitness parameter $R^2$. The $I-V$ characteristics become reproducible after the first run.
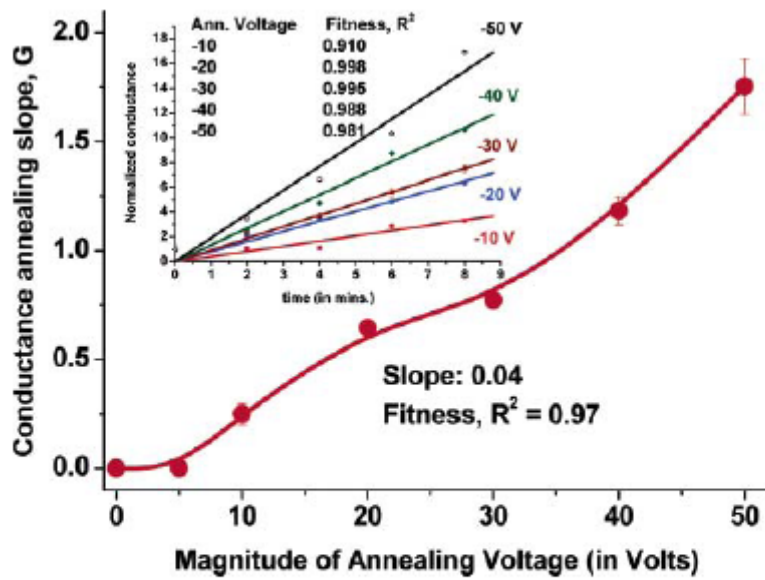
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**Figure 2.** Normalized conductance is defined as $R_i/R$, where $R_i$ is the resistance at $t = 0$ (i.e., after the third cycle in Figure 1). All the devices are on the same chip and therefore fabricated under identical conditions. The slope $G$ is in $min^{-1}$.
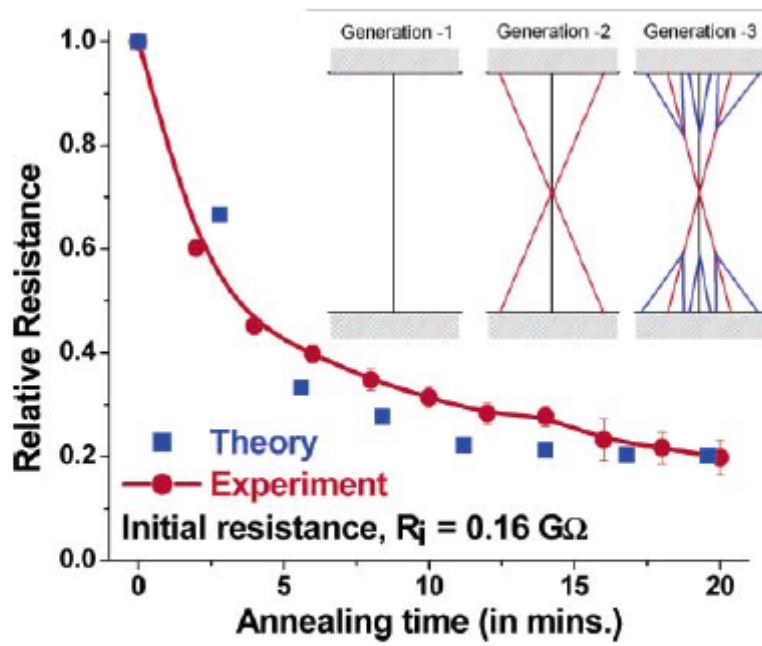
**Figure 3.** Annealing time versus relative resistance, $R/R_i$ of a sample showing the plateau region after ~20 min. The theory points are based on the percolation model for coordination number, $f + 1 = 4$. Inset shows three generations due to $f = 3$ branching. The channels are drawn as straight lines for simplicity.