Comment on "New Model System for a One-Dimensional Electron Liquid: Self-Organized Atomic Gold Chains on Ge(001)"

In a recent Letter, Schäfer *et al.* [1] claim that the Au induced nanowires on Ge(001) represent an outstanding case for a one-dimensional electron liquid. The authors report an interesting and highly remarkable change of the differential conductivity at the Fermi level by a factor of $\sim 10^2$ when comparing the nanowires with the troughs between the nanowires.

Here we show that, based on the data by Schäfer *et al.* [1], we arrive at the exact opposite conclusion, namely, that the Au/Ge(001) system cannot be considered as a one-dimensional electron liquid.

In their Letter, Schäfer *et al.* [1] show dI/dV curves recorded on the wires and in the troughs without providing current and voltage setpoints. By integrating these dI/dV curves, we have reconstructed their $I(V)$ curves [see Figs. 1(a) and 1(b)]. The resulting tunneling current at 0.3 V (-0.3 V) varies from 25 pA (50 pA) in the troughs to 1.9 nA (2.3 nA) on the wires, suggesting that the authors have used different setpoints in the troughs and on the wires. Hence the dI/dV curves cannot be compared directly. In order to compare the electronic properties of the troughs and the wires, we have normalized their dI/dV curves by dividing them by I/V. Although the normalized quantity $(dI/dV)/(I/V)$ does not reflect the exact local density of states (LDOS), it is the best one can do to compare local electronic structure information. In Fig. 1(c), the LDOS recorded on the wires and in the troughs, extracted from the dI/dV curves of Schäfer *et al.* [1], is shown.

In order to verify Schäfer *et al.*'s data [1], Au induced nanowires have been prepared by accurately following the procedure used by Schäfer *et al.* [1], i.e., deposition of 0.5

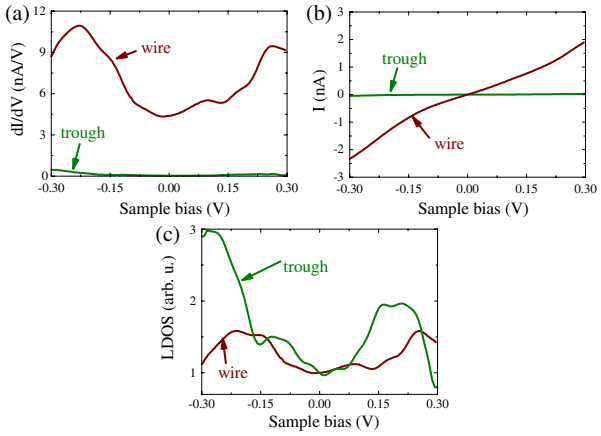

FIG. 1 (color online). (a) dI/dV curves reproduced from Fig. 4(a) of Ref. [1]. (b) $I(V)$ curves obtained by integrating the dI/dV curves in (a). (c) LDOS curves extracted from the dI/dV and $I(V)$ data of Ref. [1].

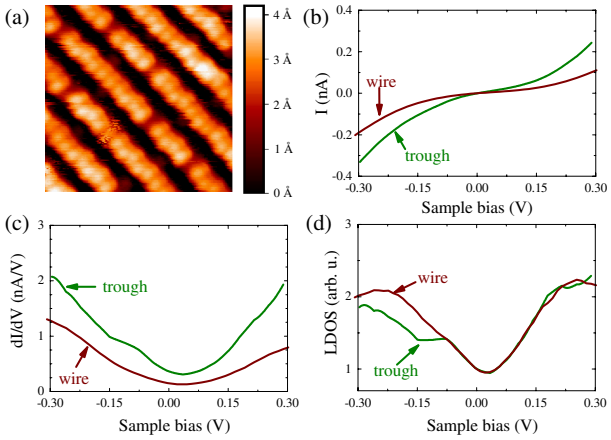

FIG. 2 (color online). (a) Scanning tunneling microscopy image (7×7 nm, $V = -1.5$ V, $I = 0.6$ nA) of Au induced nanowires on Ge(001). (b)–(d) $I(V)$, dI/dV, and LDOS curves recorded on top and in between the nanowires. Setpoint current and bias are 3.0 nA and -0.9 V, respectively.

monolayers of Au onto a Ge(001) sample kept at 775 K. The obtained structures are identical to those obtained using deposition at room temperature followed by annealing, as detailed in Ref. [2], and as reported earlier, consistent with those reported by Wang *et al.* [3]. The scanning tunneling microscopy images reveal a well-ordered array of one-dimensional structures, which are separated by 1.6 nm [see Fig. 2(a)]. In Figs. 2(b)–2(d), the $I(V)$, dI/dV, and LDOS curves recorded on the wires and in the troughs are shown. We have used the *same* setpoint values ($I = 3.0$ nA and $V = -0.9$ V) for all $I(V)$ curves. Most noticeable is the difference in the $I(V)$ and dI/dV of Schäfer *et al.* and our data. However, the LDOS curves are comparable.

In summary, we conclude and emphasize that the Au induced self-organized nanowires on Ge(001) cannot be considered as a one-dimensional electron liquid.

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Received 12 May 2009; published 11 November 2009
DOI: 10.1103/PhysRevLett.103.209701
PACS numbers: 73.20.At, 68.37.Ef, 71.10.Pm, 73.20.Mf

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