Supplementary information to:

Sn-seeded GaAs nanowires grown by MOVPE

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S1. GaAs nanowire length dependence on V/III ratio by varying TMGa flow

Since the length of Sn-seeded GaAs nanowire is very sensitive to the TMGa precursor flow at 500°C, we carried out measurements on over 90 nanowires for each sample at different spots on substrate to acquire statistically representative data. As shown in figure S1.1, the length of nanowires is strongly dependent on the TMGa flow or inversely dependent on the V/III ratio. We did the same analysis for nanowires grown with increasing AsH₃ flow as shown in figure S1.2, the length of nanowires first increases substantially, after a critical V/III ratio of 2.38 it starts to decrease with increasing AsH₃ flow.

Figure S1.1. The lengths of the nanowires are plotted against V/III ratio by increasing TMGa precursor flow while AsH₃ is holding at a fixed molar fraction of 7.68×10⁻⁵. (Dotted line is inserted as a guide to the eye only.)

Figure S1.2. The lengths of the nanowires are plotted against V/III ratio by increasing AsH₃ precursor flow while TMGa is holding at a fixed molar fraction of 4.03×10⁻⁵. (Dotted line is inserted as a guide to the eye only.)
S2. Proportion of vertical nanowires on V/III ratio by varying AsH₃ flow

It is very interesting to note from the study of AsH₃ precursor flow variation at 500°C that nanowire kinking is very closely related to the AsH₃ flow when the TMGa precursor flow is fixed at 4.03×10⁻⁵. From figure S2, one can easily identify straight vertically aligned nanowire as a dot (more round appearance) if it has multiple twin planes or triangle if it possesses pure zinc blende crystal structure or only with very few twin planes. The yield of vertical nanowires is counted for different samples as can be seen from Table S1.

![Figure S2](image)

Figure S2. Top view SEM images of nanowires grown with increasing AsH₃ flow corresponding to figure 3 shown in the paper.

| V/III ratio | 1.91 | 2.38 | 2.86 | 3.34 | 3.81 | 5.71 |
|-------------|------|------|------|------|------|------|
| Proportion of vertical nanowires(%) | 100  | 100  | 97   | 94   | 75   | 0    |

Table S1. Proportion of vertical nanowires on V/III ratio by varying AsH₃ flow
S3. Top view of kinked nanowires with high AsH₃ flow
As can be seen from the top view image below for kinked nanowires grown at high AsH₃ flow, most of the nanowires still remain the one-dimensional nanowire shape instead of forming clusters and growing straight after kinking happens in the beginning.

![Top view image of figure 3f, Sn seeded GaAs nanowires grown with high AsH₃ flow and a V/III ratio of 5.71](image)

Figure S3. Top view image of figure 3f, Sn seeded GaAs nanowires grown with high AsH₃ flow and a V/III ratio of 5.71
S4. Improved yield of vertical nanowires at 455°C

By increasing the TMGa precursor flow stepwise at 455°C while holding the AsH₃ flow constant at $7.31 \times 10^{-5}$, the yield of straight vertical nanowires is improved. From figure S3, it is clear that the increment proportion of dots or triangles, which correspond to vertical nanowires, follows the increasing TMGa precursor flow. From this result, the temperature window for nanowire growth could be further broadened by simultaneous variation of the TMGa flow and a decrease of the growth temperature.

Figure S3. Top view SEM images of Sn seeded GaAs nanowires grown at 455°C with increasing TMGa flow thus decreasing V/III ratio.