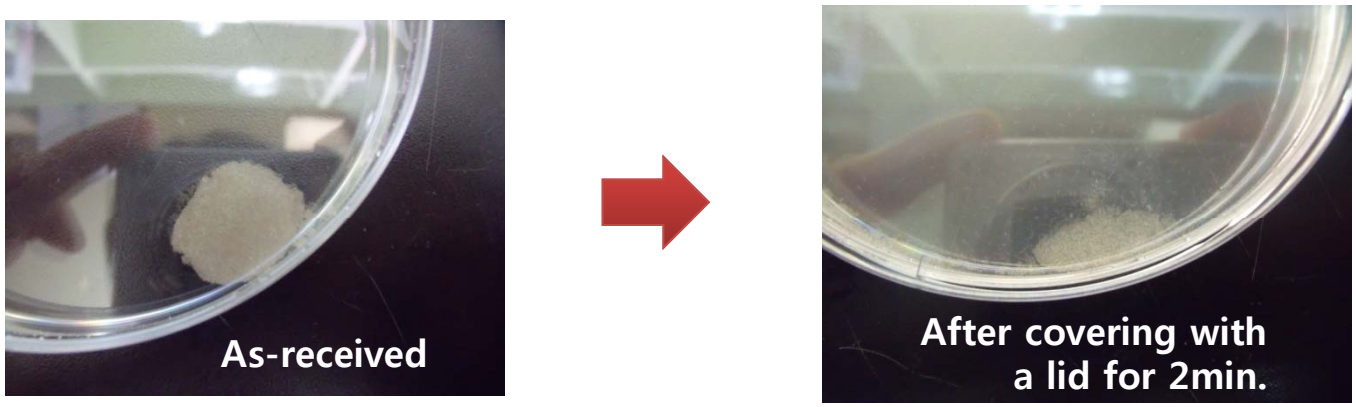
Electronic Supplementary Material (ESI) for Journal of Materials Chemistry

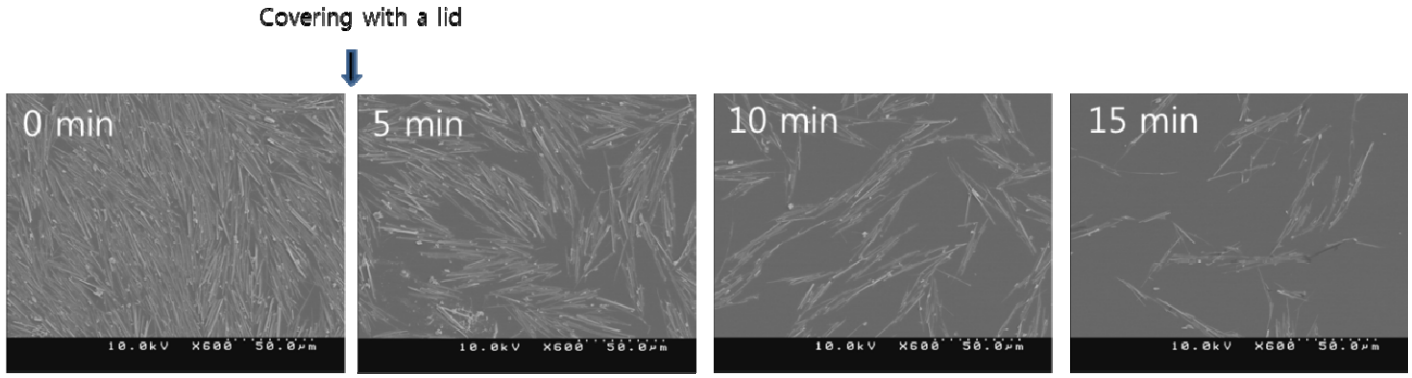
Supplementary Information 1(S1)

Destruction of a thin film of Si NWs



After several dropping Si NW solution, a thin film was appeared and then sustained.
As soon as the petri-dish was covered with a lid, the film started to be destructed and spread out over the entire surface area of the petri-dish.

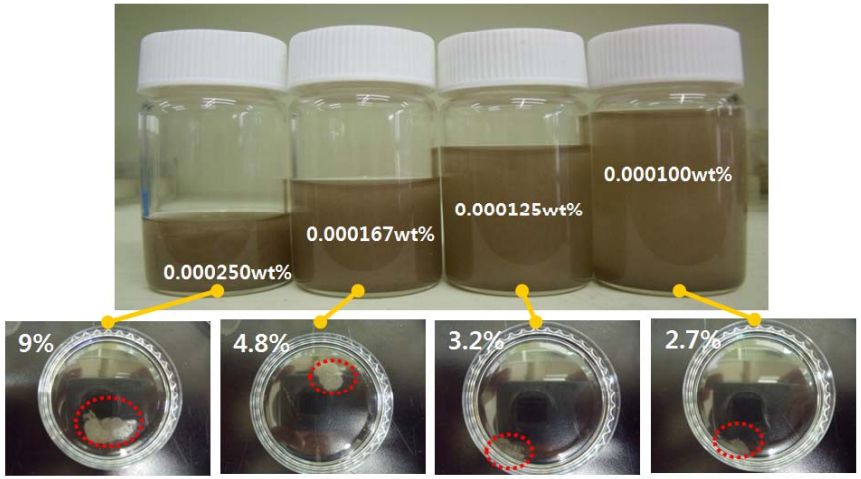
Here we attached four SEM image related to the structural destruction of silicon nanowire film as covering the petri-dish with a lid. We got the films on silicon wafer in every 5 min



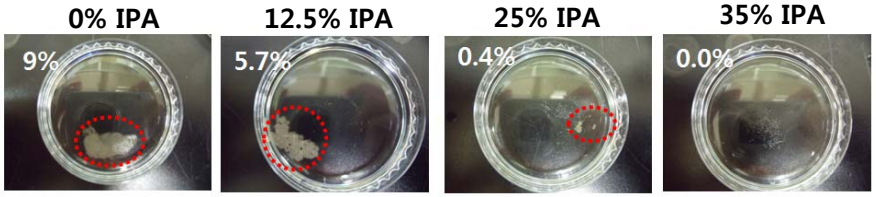
Electronic Supplementary Material (ESI) for Journal of Materials Chemistry

Supplementary Information 1(S2)

(a) Photo images related to figure 3(a)



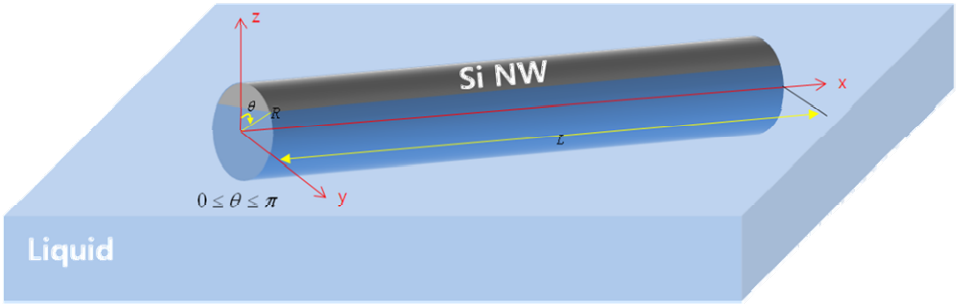
(b) Photo images related to figure 3(b)



The portions of occupying 5 cm diameter petri-dish area with the thin film were determined according to (a) the concentration of Si NW solution and (b) the initial mixing ratio aqueous HCl solution to IPA.

Supplementary Information 1(S3)

Modeling of the surface free energy potential well



IPA v/v %	Surface Tension of the solution/air (mN/m) ref[s1]	Surface tension of Si/solution (mN/m)	Contact angle
0	72	29.3	70° ref[s2]
2	62	Young's equation $\sigma_{liquid/Si} = \sigma_{air/Si} - \sigma_{liquid/air}\cos(\phi)$ Assumption : the value of surface tension of Si/solution is about 30 mN/m	
2.5	55		
5	47		
10	42		
12.5	39		
25	30		
35	27.5		
100	23	31	0° (assumed)

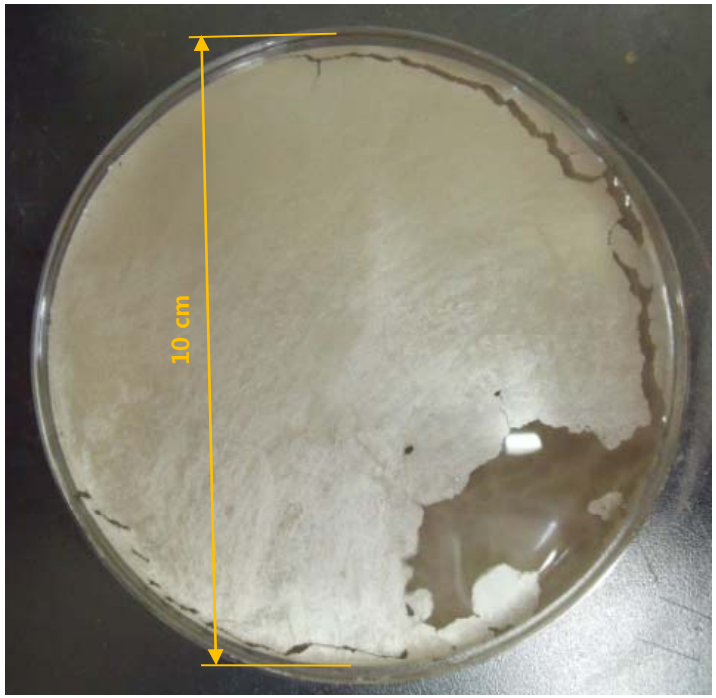
The three surface free energies related to the air/liquid, Si/liquid, and air/Si interfaces were constructed as: $E_{air/liquid} = 2\sigma_{air/liquid}\, RL\sin\theta$, $E_{Si/liquid} = 2\sigma_{Si/liquid}\, RL(\pi-\theta)$, and $E_{air/Si} = 2\sigma_{air/Si}\, RL\theta$, where $\sigma_{air/liquid}$, $\sigma_{Si/liquid}$, and $\sigma_{air/Si}$ are the surface tensions for each interface. Considering the disappearance of the air/liquid interface and the generation of the Si/liquid and air/Si interfaces when a Si NW is trapped on the surface of a liquid, the total surface free energy of this system was derived as: $E_{trapping} = E_{Si/liquid} + E_{air/Si} - E_{air/liquid}$. To simplify this equation, it was divided by $2\sigma_{air/Si}RL$ and the normalized trapping surface free energy was then obtained as: $\bar{E}_{trapping} = \theta + \sigma_{Si/liquid}(\pi-\theta)/\sigma_{air/Si} - \sigma_{air/liquid}\sin\theta/\sigma_{air/Si}$. The values of $\sigma_{air/water}$, $\sigma_{air/IPA}$, and $\sigma_{air/mixture}$ were referenced from the experimental results[s1]. The values of $\sigma_{air/Si}$ and the contact angle of water on the hydrogen-terminated Si were referenced by the experimental results of *Chyan et al.*[s2]. Because the values of $\sigma_{air/mixture}$ and the cosine of the contact angles are in seesaw relation with each other, the values of $\sigma_{Si/mixture}$ based upon Young's equation for various mixing ratio between water and IPA are assumed to be 30 *mN/m*

[s1] J. Park, J. Ryu, S. Lee, Y. Hong, T. Kim, A. Busnaina, *Journal of the Electrochemical Society* **2006**, 153, 811.
[s2] O. M. R. Chyan, J. Wu, J. Chen, *Applied Spectroscopy* **1997**, 51, 1905.

Electronic Supplementary Material (ESI) for Journal of Materials Chemistry

Supplementary Information 1(S4)

10 cm diameter of Si NW thin film

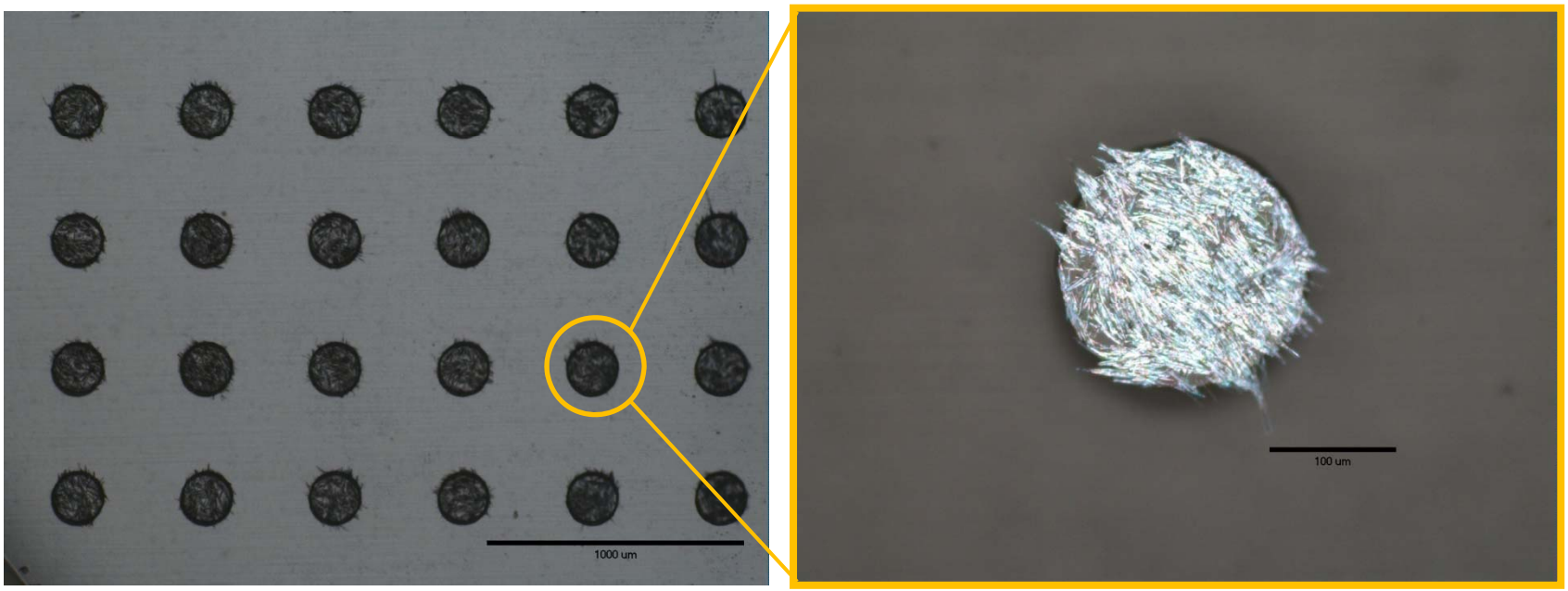


To show the possibility of the process widow over the large scale, a thin film of Si NWs in the 10 *cm* diameter petri-dish was formed. It is thought that the herringbone pattern of the film surface comes from the optical collective behavior of the close packed the single crystal Si NWs.

Electronic Supplementary Material (ESI) for Journal of Materials Chemistry

Supplementary Information 1(S5)

Pattering the Si NW thin film by PDMS mold



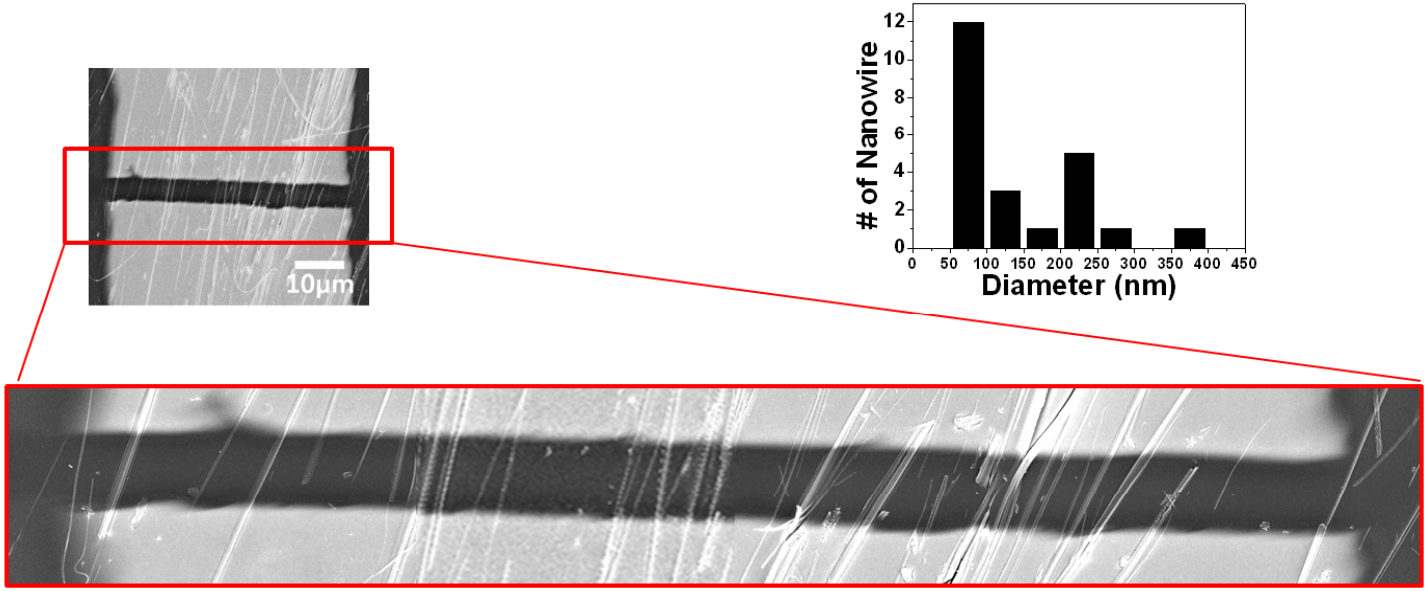
Using a periodic 200 *μm* diameter positive dot patterned PDMS, the possibility of the pattering the thin film was demonstrated. To prevent PDMS from collapsing due to large pitch of the pattern, the 100 μm height mold was set up using a conventional metal shadow mask as a master of this PDMS pattern

Electronic Supplementary Material (ESI) for Journal of Materials Chemistry

Supplementary Information 1 (S6)

Determination of effective channel width of 23 Si NW bridged FET

Total #	Mean	Sum.	Min.	Max.
23	146.5 nm	3370.6 nm	58.8 nm	353 nm



The diameters of 23 bridged Si NWs were measured and summed by 3.37 μm; the statistical analysis for 23 Si NWs was demonstrated. The range of the variation of the Si NWs after regulation was from 75 to 300 nm.