Supplementary Information

Surfactant-assisted galvanic synthesis and growth characteristics of copper nanowires

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In this study, AlO_xH_y is used instead of $Al(OH)_3$ to indicate the Al and O elements' interlayer as it is not possible to confirm if its original structure consists of $Al(OH)_3$. Originally amorphous, this interlayer forms $Al(OH)_3$ when subjected to high-energy electron beam irradiation during the TEM analysis and subsequently transform into Al_2O_3. Furthermore, a higher reaction temperature and longer reaction time are required when using the aqueous solution method to synthesize thin layers of $Al(OH)_3$.[s1]

In order to control a product's morphology during a galvanic reaction, it is necessary to consider parameters such as the pH of the solution, temperature of the reaction, quality of the sacrificial metal (substrate) and the stoichiometry of the reactants. Alternatively, thermal evaporation can be utilized to deposit a 10 μm Al film on silicon substrates, after which a galvanic displacement reaction can be induced to produce one-dimensional nanomaterials. As shown in Figure S3, copper nanobelts are formed on the evaporated Al film. As the characteristic of the sacrificial metal has been changed, the stoichiometry of the reactants has to be changed as well to produce one-dimensional nanomaterials. The dose levels of reactants are shown in Table S1.

References:

[S1] Y.-H. Chang, H.-Y. Hsu and W.-L. Lin, Synthesis of monodispersed hexagonal and star-like gibbsite nanoplatelets by sol-gel method, *Mater. Lett.*, 2017, **194**, 202-204.

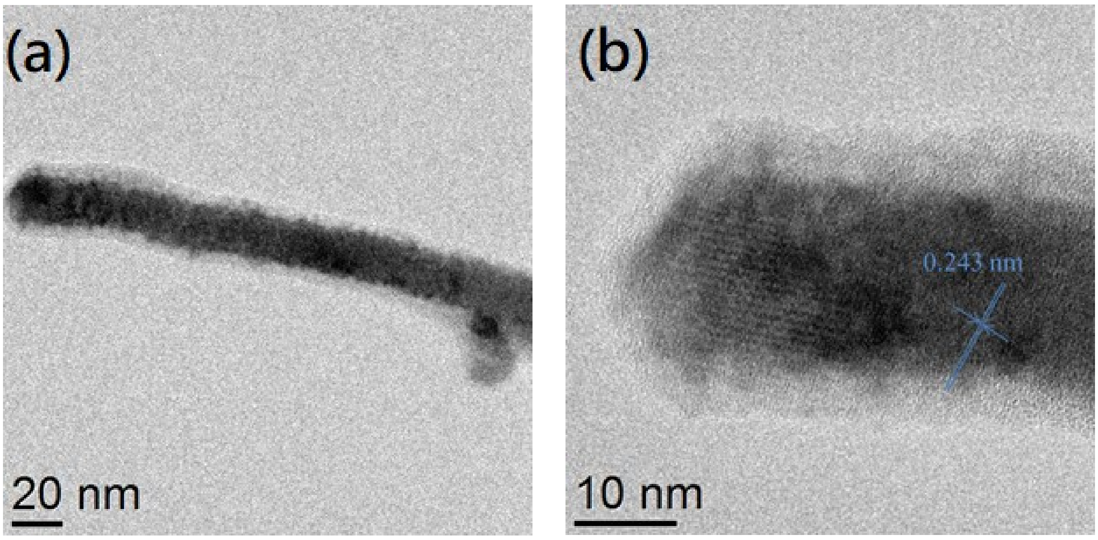
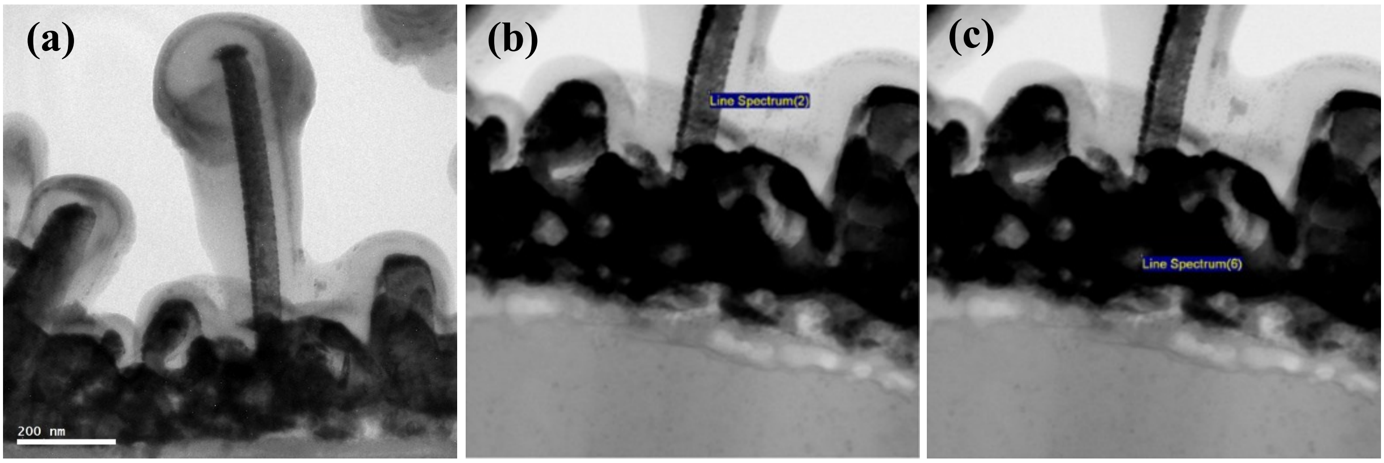
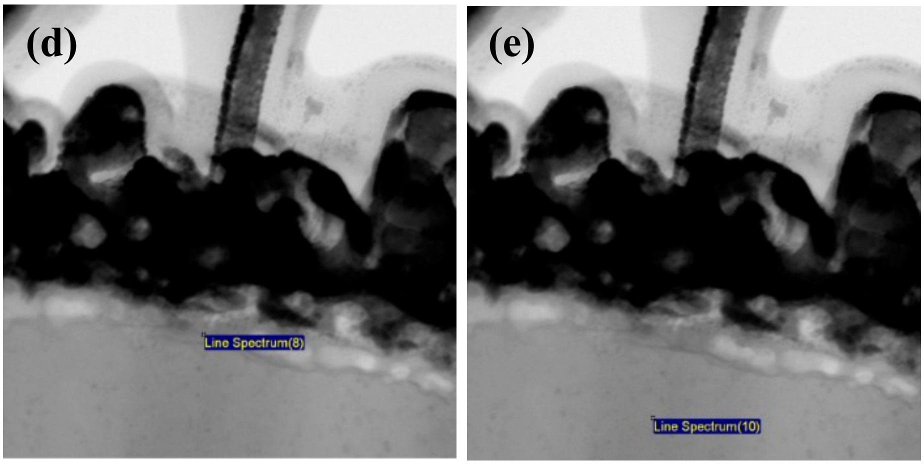


Fig. S1. (a) Another TEM image of a CuNW, (b) an HRTEM image near the head of the CuNW. The lattice fringes of the outer layer in (b) indicate the Cu_2O (111) planes, separated by 0.243 nm. TEM analysis and EDS show that the CuNW is covered by a thin layer of Cu_2O. Cu_2O is usually formed as the native oxide layer on copper materials because of atmospheric contact.





(f)

	O (%)	Al (%)	Cu (%)
S2b	10.93	3.45	85.61
S2c	19.66	6.29	74.04
S2d	44.25	53.60	2.15S
S2e	10.10	89.17	0.73

Fig. S2. (a)~(e) EDS measurement is used to analyze the different sections of the sample; (f) atomic ratio of the elements in each section.

Table S1. Experimental parameters when using thermally evaporated Al film as the substrate for the synthesis of one-dimensional copper nanomaterials

	Temperature (℃)	Reaction time (h)	$CuCl_2$ (mM)	CTAC (mM)	HNO_3 (μL)
A	21	20	3.5	2	22
B	21	20	4	2	22
C	21	20	4.5	2	22
D	21	20	5	2	22

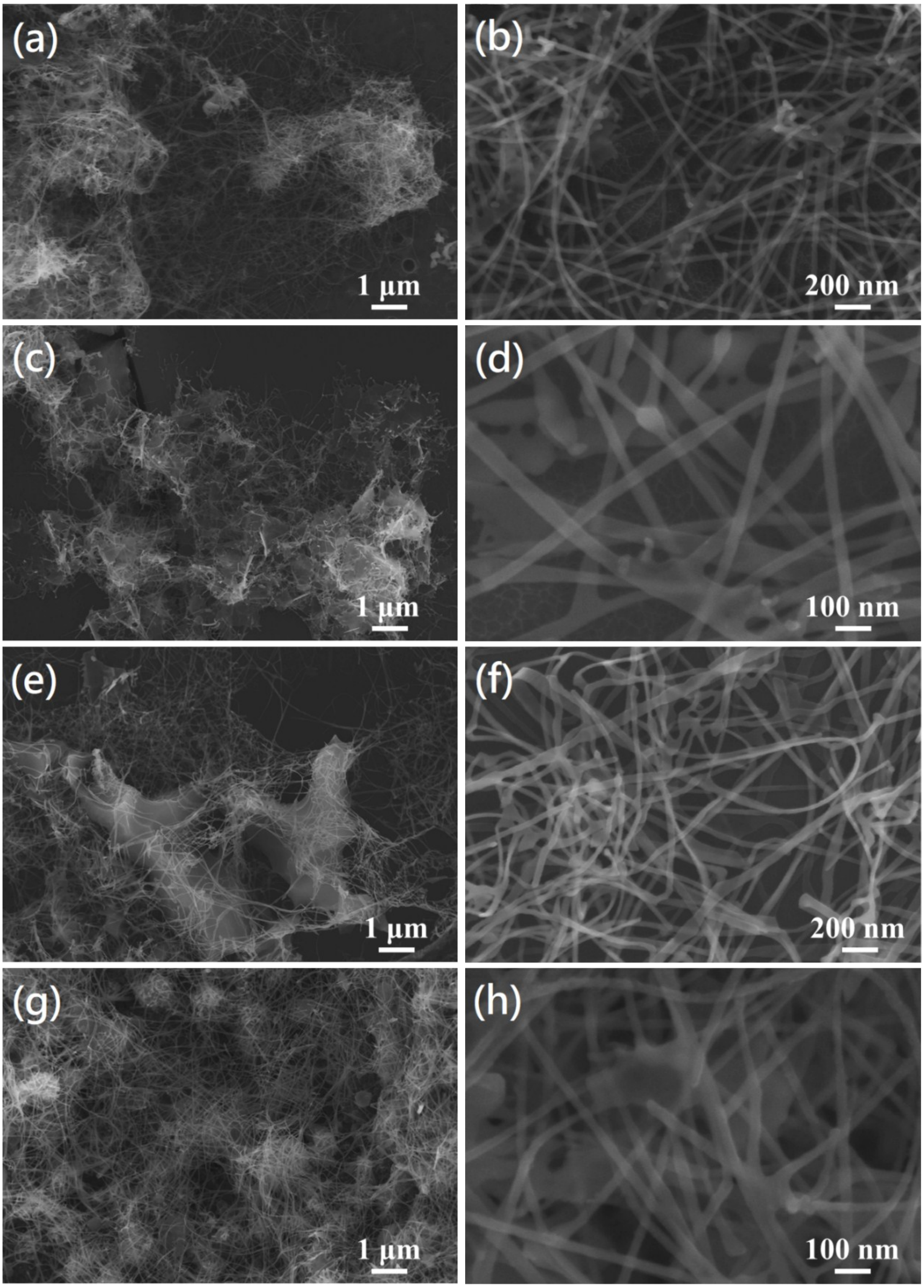
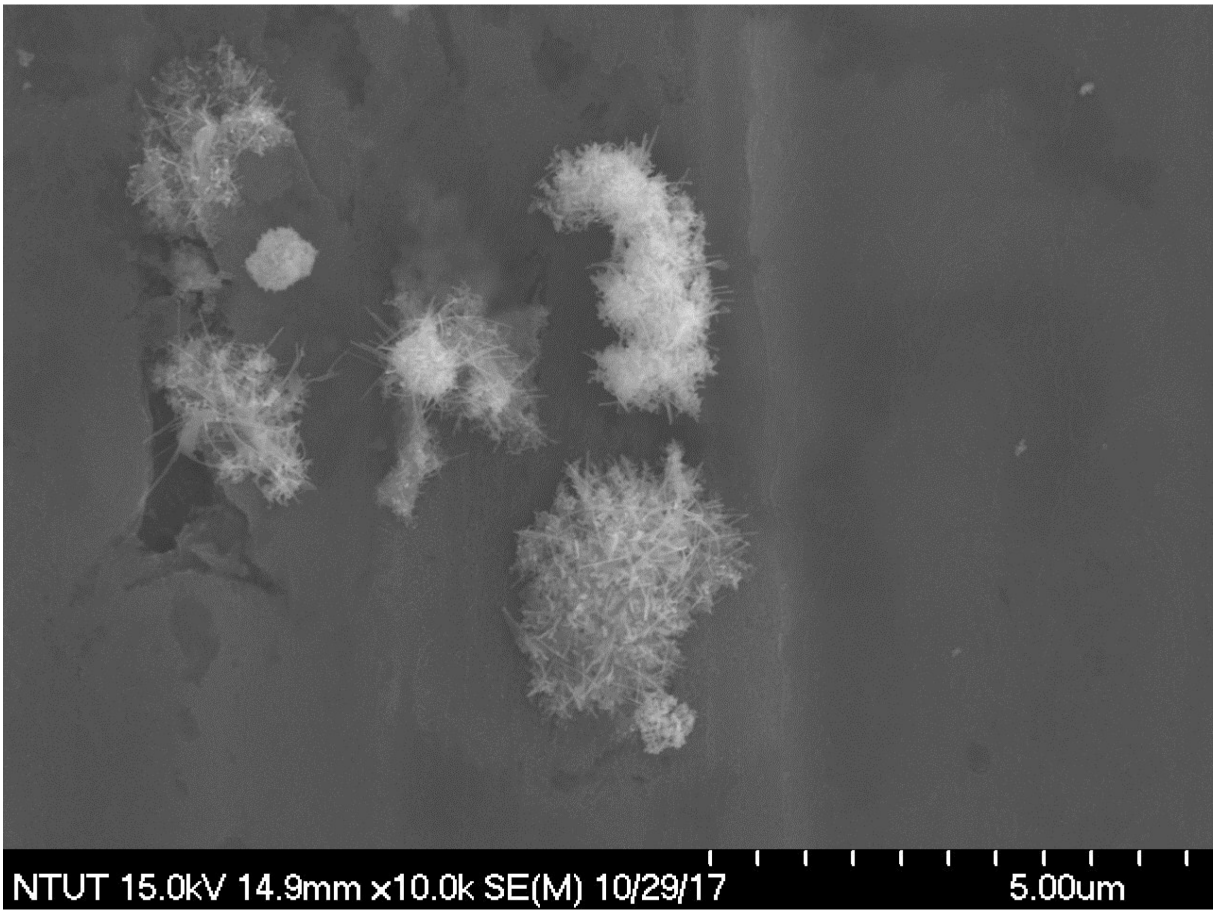


Fig. S3. When a thermally evaporated Al thin film with a thickness of 10 µm is deposited on Si(100) and used as a substrate for the reaction, it is also possible to synthesize one-dimensional copper nanomaterials. (a)(b), (c)(d), (e)(f), (g)(h) are the SEM images of the products obtained *via* reactions A, B, C, and D (Table S1). When the $CuCl_2$ concentration is lower, the yield becomes lower and the product takes on a primarily belt-like morphology as shown in Figures (a)-(f). When the $CuCl_2$ concentration is raised to 5 mM, the SEM images show that the reaction produces a higher yield, as shown in Figures (g)-(h).

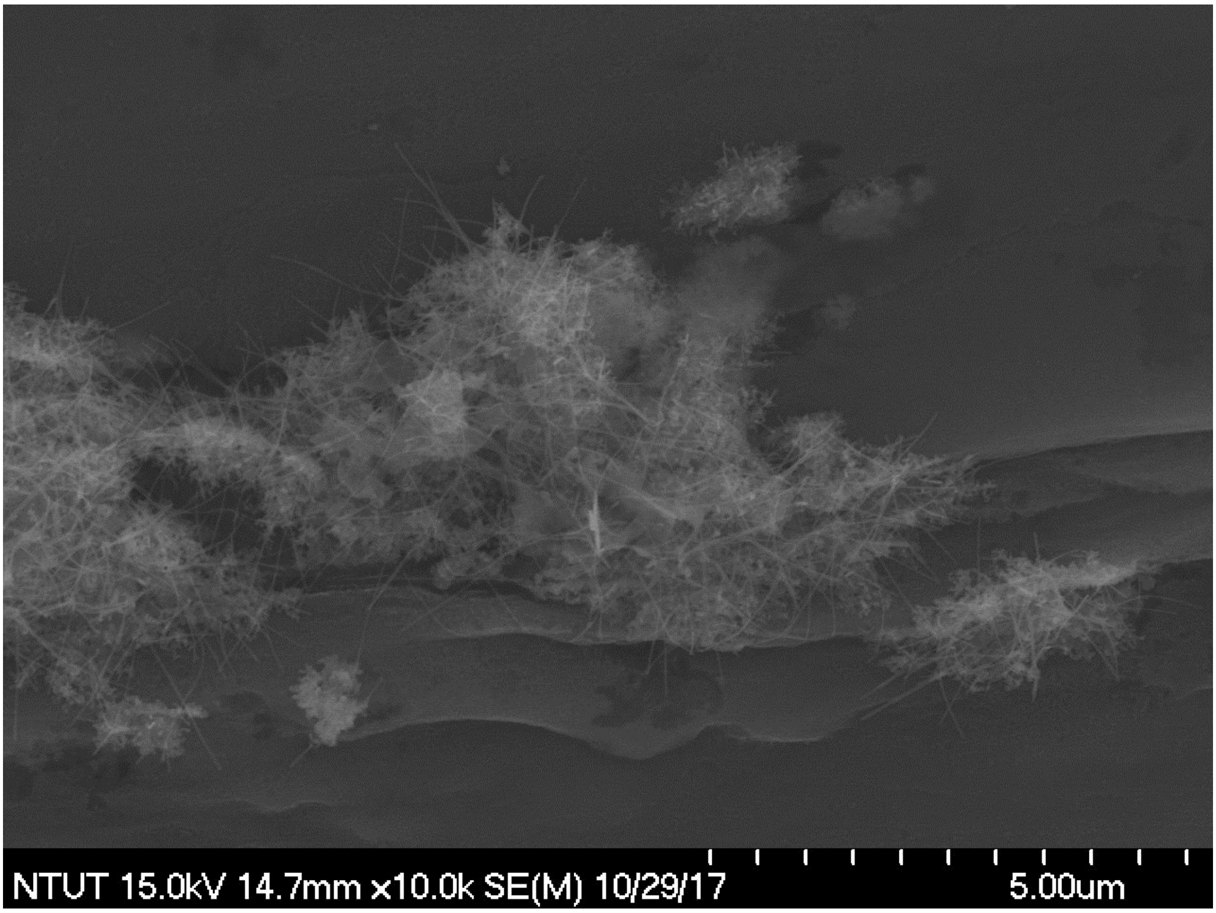
Table S2. Degree of degradation *vs.* time for the reaction shown in Figure 8b.

Time (min)	Degree of degradation (%)
3	13
6	23
9	30
12	38
15	45
18	51
21	56
24	64

(a)



(b)



(c)

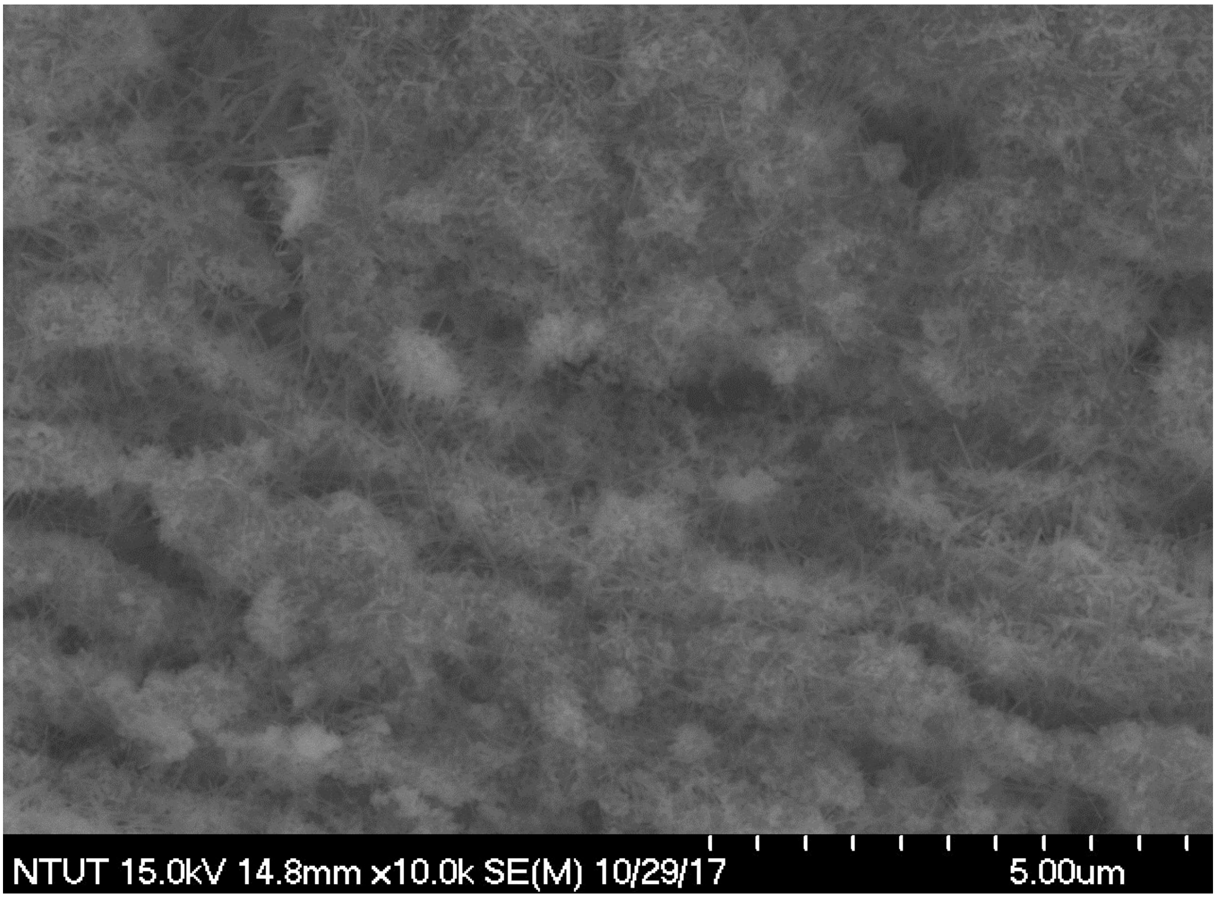


Fig. S4. The original SEM images in Fig. 3 (a)~(c).