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IT-3-P-5751 Light induced in situ observation technology in EM

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Compare with optical microscope (OM), electron microscope (EM) has the advantage with higher resolution. Therefore, when Hans Busch developed the first electromagnetic lens in 1926 [1], the technique of electron microscope has attracted increasing attention. The first commercial transmission electron microscope (TEM) were produced in 1939 by Siemens. [2] In today's development, EM is important for the use of observing smaller sample which like the microstructure of the materials, the device in MEMS manufacturing and microbiological analysis. On the other hand, since the rise of environmental awareness, green energy become more and more concerned recently and solar energy is one of the candidates. As a result, a growing number of researchers are studying on using catalysts to transfer light into chemical energy. However, the efficiency of commercial solar energy devices still lower than 30 %, we thick it may be limited by the comprehension and observation of reaction mechanisms. Due to the importance of solar energy, we designed an experiment combined the observation of light-induced reaction and electron microscope.

In our experiment, two kinds of light-induced system using in electron microscope are produced. They are named "LED-based system" and "fiber-based system". Figure 1(a) and (b) showed the"LED-based system" and "fiber-based system" respectively. The "LED-based system" contains a light-emission diode (LED) put under the sample holder and controlled by a power supply. This kind of light-induced system is used in Hitachi TM-1000. Another "fiber-based system" includes a UV light source with optical fiber to induce UV light through the EDS hole for JEM-2010. Then we use the wet-cell sealing technology [3] to fabricate the wet sample containing TiO_2, H_2O, CH_3OH and H_2PtCl_6 solution. Finally, we successfully observe the in-situ light-induced deposition reaction in EM. Figure 2 showed the deposition process in scanning electron microscopy (SEM). When light Illuminate about 3 minutes, the Pt particles began to emerge in the upper right corner.

Reference:

[1] Mathys, Daniel, Zentrum für Mikroskopie, University of Basel: Die Entwicklung der Elektronenmikroskopie vom Bild über die Analyse zum Nanolabor, p. 8

[2] "James Hillier". Inventor of the Week: Archive. 2003-05-01. Retrieved 2010-01-31.

[3] Tsu-Wei Huang, Shih-Yi Liu, Yun-Ju Chuang, Hsin-Yi Hsieh, Chun-Ying Tsai, Yun-Tzu Huang, Utkur Mirsaidov, Paul Matsudaira, Fan-Gang Tseng, Chia-Shen Chang and Fu-Rong Chen, Lab Chip, 2012,12, 340-347.

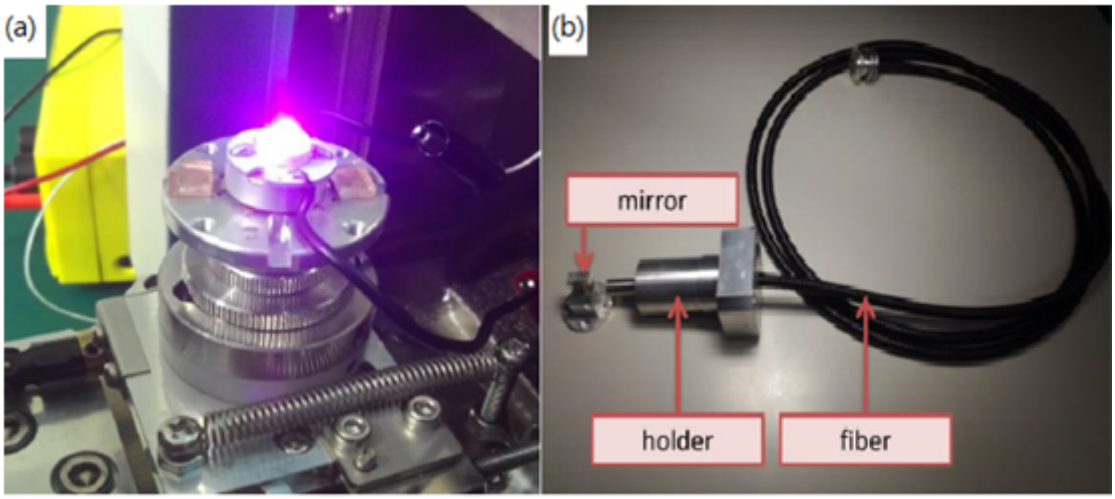

Fig. 1: Figure 1 Two light-induced system development which named (a) the”LED-based system”, and (b) the“fiber-based system”.

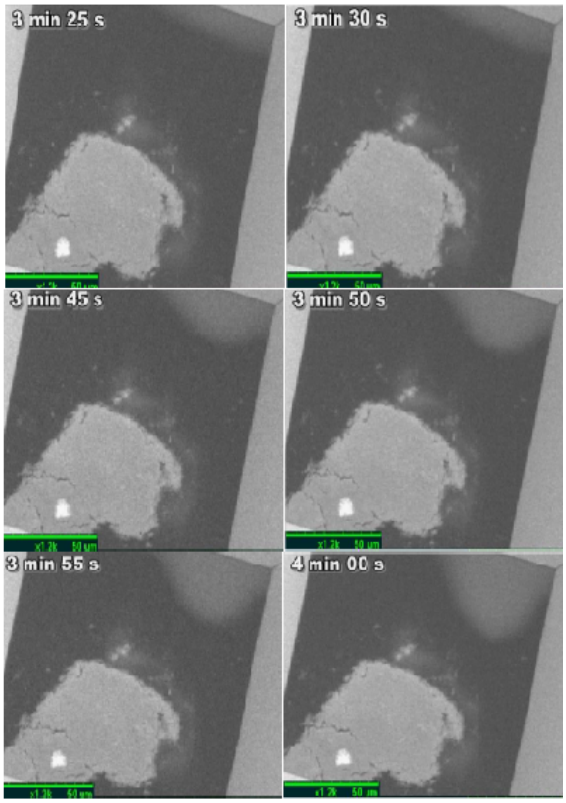

Fig. 2: Figure 2 The deposition process in scanning electron microscopy (SEM).