

課題番号 : F-14-HK-0070
利用形態 : 共同研究
利用課題名(日本語) :
Program Title (English) : Surface-plasmon-mediated nanofabrication of oriented silver nanoplates
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1. 概要(Summary)

We demonstrated polarized femtosecond laser-light mediated growth and programmable assembly of photoreduced silver nanoparticles into triply hierarchical micropatterns. Formation of erected arrays of nanoplates with a thickness as small as $\lambda/27$ (λ , the incident laser wavelength) level is shown. field to assemble the silver nanoparticles directly. The triply hierarchical micropattern shape and location, the nanoplate orientation, and thickness are all attained in controlled fashion.

2. 実験(Experimental)

• Apparatus

Mask Aligner, Helicon sputtering

• Method

The silver precursor was prepared by dripping a suitable amount of aqueous ammonia onto a mixture of silver nitrate aqueous solution stirring until a clear solution was formed. The microchannel was fabricated on a normal glass substrate by using photolithography and wet etching techniques. The 800 nm femtosecond laser pulse, with a width of 120 fs and mode locked at 82 MHz, was tightly focused by a high numerical aperture (NA = 1.4) oilimmersion objective lens (100X). The silver nanoplates were fabricated with 1000 μ s exposure duration at each dot.

3. 結果と考察(Results and Discussion)

Fig. 1 shows SEM image of a silver circle array patterned on the bed at the intersection of two microchannels. It is interesting to recognize from the magnified scanning electron microscopic (SEM) image that the micropatterns are actually composed of subwavelength nanoplates. They are perpendicular to the substrate and possess a thickness on the order of several tens of nanometers, which is one-tenth of the applied laser

wavelength. The array of the erected nanoplates is apparently different from the periodic structures created by interference, either between the incident laser beams or between the incident beam and its excited waves, where patterns are replicas of light intensity redistributions. The growth mechanism of nanoplates has been clarified: (i) the excited surface plasmons enhance the local electric field and lead to spatially selective growth of silver atoms at the opposite ends of dipoles induced on early created silver seeds; (ii) the optical attractive force overcomes electrostatic repulsion in the enhanced local electric field to assemble the silver nanoparticles directly.

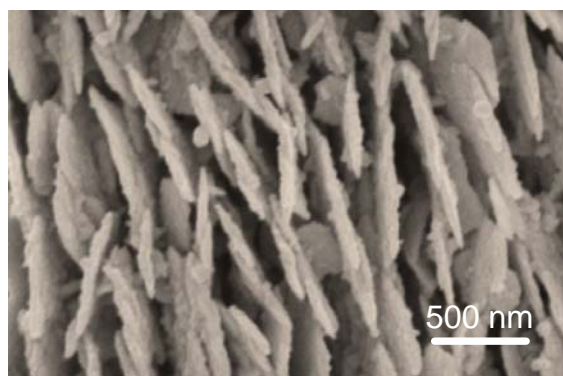


Fig. 1 SEM image of a silver circle array patterned on the bed at the intersection of two microchannels.

4. その他・特記事項(Others)

• 共同研究者等 (Coauthor) : (RIES, Hokkaido University) K. Ueno, H. Misawa

5. 論文・学会発表(Publication/Presentation)

(1) B.-B. Xu, L. Wang, Z.-C. Ma, R. Zhang, Q. Chen, C. Lv, B. Han, X.-Z. Xiao, X.-L. Zhang, Y.-L. Zhang, K. Ueno, H. Misawa, H.-B. Sun, *ACS Nano*, **8**, 6682-6692 (2014).

6. 関連特許(Patent)

なし