Ag-Ag_2S core-shell nanoparticles synthesis and random network fabrication for neuromorphic device

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Brain-like devices has a high performance arithmetic circuit with very low power consumption. The system mimicking human brain information processing is expected to be applied in many fields. Previously, we successfully collected the nanoparticles located between electrodes by using dielectrophoresis (DEP) method and study its electrical behavior before and after connection occurred as shown in **Figure I**, indicating the nanoparticles were collected by DEP and metallic bridge was formed after applying certain bias. Furthermore, the electrical properties were also investigated using I-V Sweep measurement of 0-5V with 100 times repetition as shown in **Figure II**. As can be seen from the figure, electrical conductivity was changed after repeating sweep. In the present study, we demonstrated a new approach to synthesis the Ag-Ag_2S core-shell nanoparticles for neuromorphic device application. To fabricate random network, in the first step, 2.08 g of silver acetate in 20 mL Toluene and 10 g of dodecylamine (DDA) was used as starting materials. Then, 2.08 g of phenylhydrazine in 20 mL Toluene was added dropwise to the silver acetate solution with stirring in oil bath at 60°C and 300 rpm for 1 h. The black color solution was obtained during dropwise process, indicating the formation of DDA-capped Ag nanoparticles. The Ag/DDA was then filtered and then the sulfurizing process was performed in wet chemical reaction by utilizing $Na_2S \cdot 9H_2O$ aqueous solution as the source of sulfur ions. The solution was then filtered and centrifugated at 2600 G for 30 min to separate the nanoparticles. **Figure III** showed the XRD pattern of the effect of reaction time and concentration of $Na_2S \cdot 9H_2O$. We also tried to fabricate nanoparticles gathering by using DEP and measured its electrical properties. The detail will be presented in the conference.

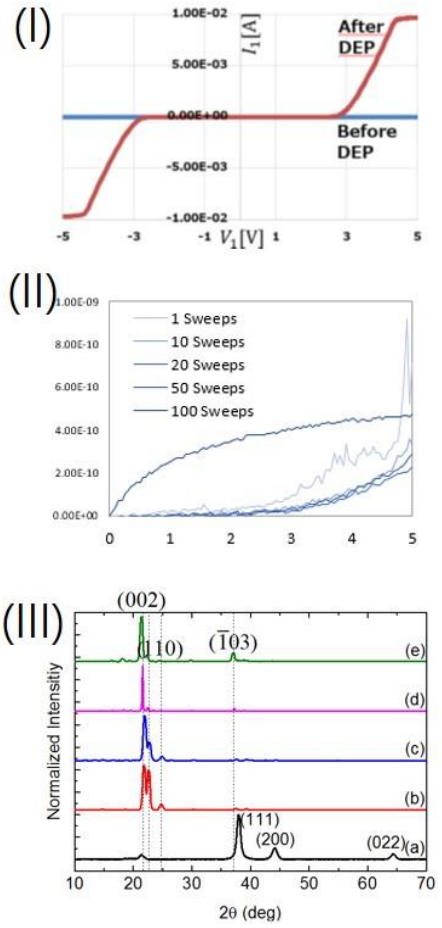

Figure (I) Before and after DEP process
Figure (II) I-V Sweep at 1,10,20,50,100 times of measurement
Figure (III) XRD Pattern of Ag nanoparticles (a) and Ag2S (b-e)

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