Towards reservoir computing hardware using Ag-Ag_2S core-shell nanoparticles

Kyushu Institute of Technology, LSSE Hadiyawarman[1], Hirofumi Tanaka[1]*
*E-mail: tanaka@brain.kyutech.ac.jp

Neuromorphic devices are expected to have a high-performance arithmetic circuit with very low power consumption to be applied in many fields, such as brain-like computer. In the present study, we demonstrated a reservoir computing hardware using the Ag-Ag_2S core-shell nanoparticles aggregation. The Ag-Ag_2S core-shell nanoparticles were synthesized by modified Brust-Schiffrin procedure at room temperature with Ag/S molar ratios of 0.25/1. The fabrication of Ag-Ag_2S core-shell nanoparticles with Ag/S molar ratios of 0.25/1 is as follows: A toluene solution of allylmercaptane (0.37 mL, 4.71 mmol) is mixed with a solution of silver nitrate (200 mg, 1.18 mmol). Then, tetraoctylammonium bromide in deionized (DI) water (360 mg, 0.658 mmol) was added to the solution and followed by adding sodium borohydride solution in DI water (260 mg, 6.87 mmol). The mixture was allowed to react for 2 h at room temperature with magnetic stirring. The water phase was then removed from obtained solution and then was centrifuged at 4000 rpm for 20 min to separate the nanoparticles from the liquid phase. The structural properties of Ag-Ag_2S nanoparticles were confirmed by XRD, XPS and TEM. Next, to create aggregation of particles, the highly concentrated nanoparticles in ethanol were drop-casted on to 50 ℃ of multi electrodes device and characterized the requirements for building the physical reservoir computing, such as nonlinearity, high dimensionality and fading memory. Finally, the desired waveform was successfully generated with higher accuracy and lower error by training readout output as shown in **Figure 1**. The use of nanoparticles demonstrated here showing better accuracy with low number of readout channel than that of using nanowires as reported previously [1].

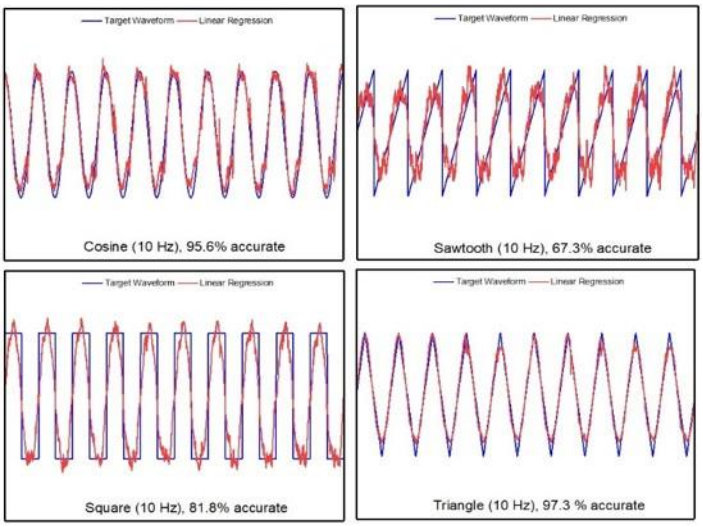

Figure 1 Waveform generation from 7readout channels with highest accuracy

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Reference:

[1] E. C. Demis et al., Jpn. J. Appl. Phys. 55, 1102B2 (2016)