Electronic Supplementary Material (ESI) for RSC Advances.

Supplementary Information

Autonomous electrochemically-actuated microvalve for controlled transport in stand-alone microfluidic systems

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Binary logic system

Figure S1 shows a microfluidic system for performing 2-bit binary OR and AND logical operations. The system input is a solution placed in the input reservoir (IR), where a binary logic “1” represents the presence of a solution and an absence of a solution is a binary “0”. A solution flow from the output reservoir (OR) to the output microchannel (OMC) is the output signal, where a solution in the OMC represents a logic “1” and no solution in the OMC is a logic “0”. Figure S1 (A) is an OR operation, where a solution in either IR A or IR B, the result in OMC is “1”. Figure S1 (B) is an AND operation, where a solution present in both IR A and IR B, the result in OMC is “1”.

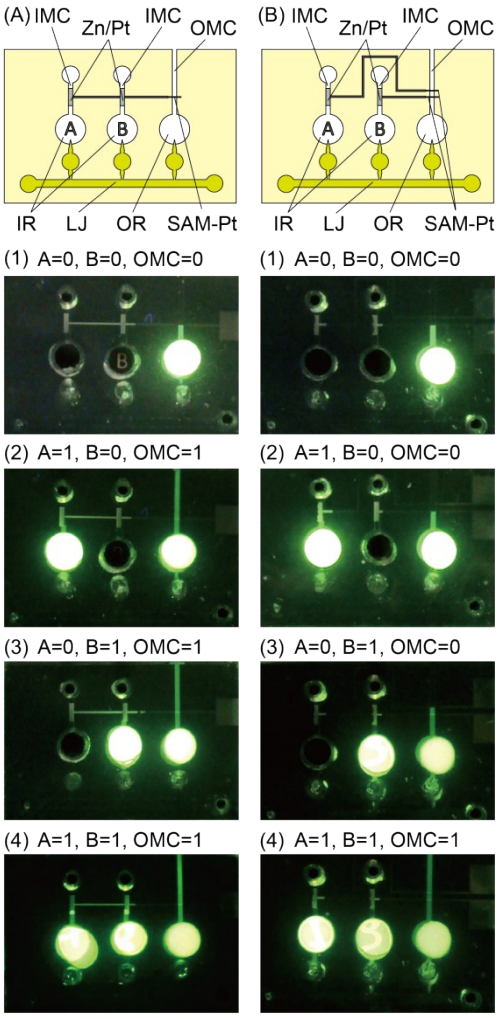

Fig. S1 2-bit binary logic circuits. (A) Schematic of OR circuit. (A1-A4) Demonstration of each OR operation. (B) Schematic of AND circuit. (B1-B4) Demonstration of each AND operation. IR: input reservoir, IMC: input microchannel, OR: output reservoir, OMC: output microchannel, LJ: liquid junction.

Microfluidic display

Figure S2 shows a microfluidic-based display of Roman characters A, B, C, and D. The microvalves are located at the bottom of the solution microchannel (SMC) connected to each character, and the Zn/Pt electrodes were formed at the end of characters A, B, and C. When a solution in the sample reservoir (SR) moves in the horizontal SMC and reaches the Zn/Pt electrode at the end of the vertical microchannel, the microvalve for character A opens. When the solution wets the Zn/Pt electrode at the end of character A, the microvalve for character B opens. The same steps were repeated and each character was displayed sequentially.

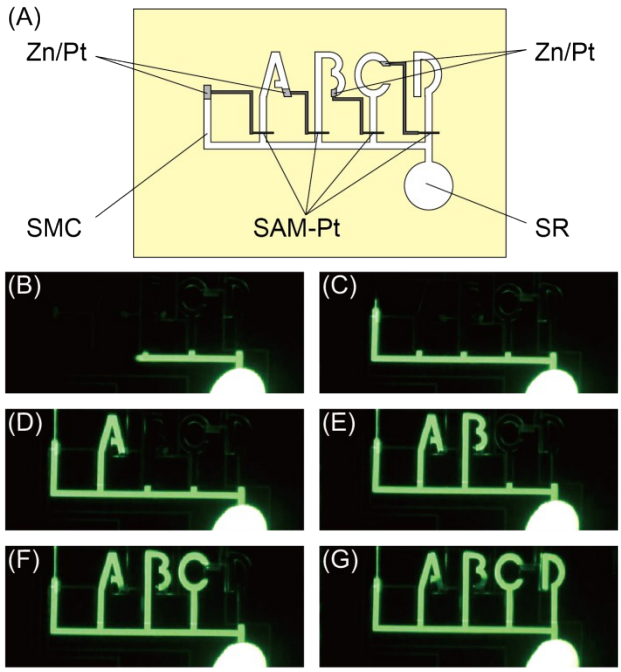

Fig. S2 Microfluidic-based display of Roman characters. (A) Schematic layout of the SMCs, SAM-Pt microvalves, and Zn/Pt electrodes. (B)–(G) Sequential movement of solution and display of each character. SMC: solution microchannel, SR: sample reservoir.