Self-assambled ZnO nano-tetrapod network for neuromorphic computing

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ZnO nanotetrapods are low-cost, low-toxicity semiconductor nanostructures that form highly porous, three-dimensional self-supported networks with large surface area and efficient charge transport. These properties make them promising candidates for hardware neuromorphic computing platforms. In this work, we demonstrate a simple and scalable low-temperature spray-coating method for fabricating ZnO nanotetrapod network devices without the need for complex lithography or high-vacuum processing. The approach enables controllable network thickness, morphology, and connectivity across a wide range of substrates, supporting flexible device design. We systematically evaluate the neuromorphic behavior of multiple devices under both electrical and UV optical pulsed stimulation, observing reproducible synaptic functionalities in purely electrical and optoelectronic modes. Statistical analysis confirms strong device-to-device repeatability, highlighting the robustness of the fabrication process. Furthermore, we correlate network packing and processing parameters with electrical and photoresponsive performance, identifying conditions suitable for reliable dual-mode operation. These results position self-assembled ZnO nanotetrapod networks as a versatile and scalable materials platform for future neuromorphic computing architectures.
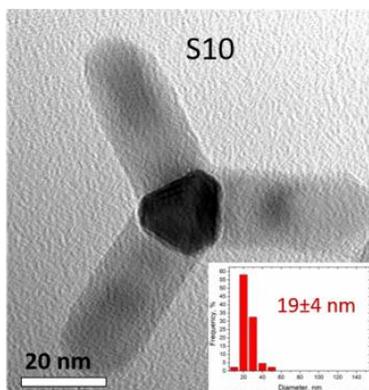
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