Visual memory in a 2D memitter

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In the era of Big Data and Artificial Intelligence, there is a growing expectation for neuromorphic systems to outperform the current limitations of computing technology by emulating the information processing capabilities of the human brain. Neuromorphic architectures, both electronic and optical, have been developed for implementing neural networks and brain-inspired computing paradigms. Adaptive materials are also proposed for in-sensor information processing, eliminating the need for data transfer between sensors and computing units. Among emerging neuromorphic technologies, materials able to adapt their response to external stimulation have been used to emulate synaptic plasticity and neuron functionalities, with 2D materials showing promise due to their scalability and integration capabilities. Here we introduce the novel concept of a "2D memitter" that uses WS_2 monolayers to achieve all-optical neuromorphic data processing. We demonstrate the time-dependent, highly nonlinear photoluminescence (PL) response of WS_2 flakes under optical stimulation, which exhibits fading memory characteristics and synaptic behavior. Through experimental and modeling approaches, we illustrate the potential for PL dynamics to replicate biological functions like the Visual Short-Term Memory.