Combining hot carrier photodetector and memristor in one device - evaluation of applicability for neuromorphic visual systems.

In an era of increasing demand for computing power, traditional computers are becoming more energy-hungry, posing a significant environmental challenge. A solution may be drawing inspiration from the human brain – a remarkably efficient and energy-saving command center.

Our brain, composed of billions of neurons connected by trillions of synapses, consumes a mere 20-40 watts of power while effortlessly handling tasks incredibly demanding for computers. The secret lies in parallel information processing and "in-memory computing" – operations performed directly on data without the need for transfer.

Our research project aims to create a neuromorphic device that mimics these extraordinary brain characteristics. We utilize a special type of memory called ReRAM, where information is stored as changes in resistance, similar to how synapses function. Additionally, we introduce an innovative combination of materials: titanium nitride (durable and with intriguing optical properties), group IVb metal oxides, and graphene (transparent and highly conductive). This combination allows our device to respond to both voltage and light, opening new possibilities in the field of neuromorphic computing.

What are we researching?

We aim to create an efficient and reliable memory cell that will serve as the foundation for future neuromorphic computers. We are investigating different methods of fabricating the device's dielectric (insulating) layer to find optimal parameters that ensure its speed, reliability, and reproducibility.

Why is this important?

The development of energy-efficient and high-performance neuromorphic computers has the potential to revolutionize numerous fields. Imagine robots capable of self-learning and adaptation, autonomous vehicles making split-second decisions, or precise diagnostic medical devices. Our project is a step towards a future where computers operate as efficiently and intelligently as the human brain, while minimizing their negative environmental impact.