Organic electronics for neuromorphic computing

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Neuromorphic computing could address the inherent limitations of conventional silicon technology in dedicated machine learning applications. Recent work on silicon-based asynchronous spiking neural networks and large crossbar-arrays of two-terminal memristive devices has led to the development of promising neuromorphic systems. However, delivering a parallel computation technology, capable of implementing compact and efficient artificial neural networks in hardware, remains a significant challenge. Organic electronic materials offer an attractive alternative to such systems and could provide neuromorphic devices with low-energy switching and excellent tunability, while being biocompatible and relatively inexpensive.

This talk describes state-of-the-art organic neuromorphic devices and provides an overview of the current challenges in the field and attempts to address them[1]. We demonstrate a novel concept based on an organic electrochemical transistor[2] and show how some challenges in the field such as stability, linearity and state retention can be overcome[3].

Furthermore, we investigate chemical doping mechanisms in the active material for improved material functionality and introduce concepts to combine neuromorphic computing with biological cells and tissues, opening up possibilities in brain-machine interfacing and adaptive learning of artificial organs.

[1.] van de Burgt et al. Nature Electronics, 2018
[2.] van de Burgt et al. Nature Materials, 2017
[3.] Keene et al. J Phys D, 2018