

The Fourth Element (or the rediscovered memristor)

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Memristor is the fourth fundamental circuit element which was predicted in the 1970s and rediscovered in HP labs in 2008. The HP memristor, is constructed using a nanometer scale TiO₂ thin-film that comprises a doped and an undoped region. It is a novel circuit element with very good memory and switching properties, nano-size dimensions, low power consumption, and good compatibility with complementary metal oxide semiconductor (CMOS) integrated circuits.

The potential applications of memristors are not only limited to artificial biological systems and nonvolatile RAM, but also extend to reconfigurable nanoelectronics. Furthermore, memristors introduce novel paradigms in the application-specific integrated circuits (ICs) and field-programmable gate arrays (FPGAs) domains. The implementation of memristors in ICs offers unprecedented memory capacity and device density, while occupying a significantly smaller area. Memristors could be used for energy-efficient storing and processing information in high-density integrated chips applicable in nonvolatile memories, artificial neural networks, and neuromorphic computing circuits.

In this lecture, an introduction to memristors is given, along with the presentation of mathematical and SPICE models for these devices. Additionally, an overview of the potential applications of memristors is provided.