New 'smart' materials for the brain

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Research done by scientists in Italy and Switzerland has shown that carbon nanotubes may be the ideal "smart" brain material. Their results, published December 21 in the advance online edition of the journal *Nature Nanotechnology*, are a promising step forward in the search to find ways to "bypass" faulty brain wiring.

The research shows that carbon nanotubes, which, like neurons, are highly electrically conductive, form extremely tight contacts with neuronal cell membranes. Unlike the metal electrodes that are currently used in research and clinical applications, the nanotubes can create shortcuts between the distal and proximal compartments of the neuron, resulting in enhanced neuronal excitability.

The study was conducted in the Laboratory of Neural Microcircuitry at EPFL in Switzerland and led by Michel Giugliano (now an assistant professor at the University of Antwerp) and University of Trieste professor Laura Ballerini. "This result is extremely relevant for the emerging field of neuro-engineering and neuroprosthetics," explains Giugliano, who hypothesizes that the nanotubes could be used as a new building block of novel "electrical bypass" systems for treating traumatic injury of the central nervous system. Carbon nano-electrodes could also be used to replace metal parts in clinical applications such as deep brain stimulation for the treatment of Parkinson's disease or severe depression. And they show promise as a whole new class of "smart" materials for use in a wide range of potential neuroprosthetic applications.

Henry Markram, head of the Laboratory of Neural Microcircuitry and

an author on the paper, adds: "There are three fundamental obstacles to developing reliable neuroprosthetics: 1) stable interfacing of electromechanical devices with neural tissue, 2) understanding how to stimulate the neural tissue, and 3) understanding what signals to record from the neurons in order for the device to make an automatic and appropriate decision to stimulate. The new carbon nanotube-based interface technology discovered together with state of the art simulations of brain-machine interfaces is the key to developing all types of neuroprosthetics -- sight, sound, smell, motion, vetoing epileptic attacks, spinal bypasses, as well as repairing and even enhancing cognitive functions."

Source: Ecole Polytechnique Fédérale de Lausanne