**ABSTRACT**: Our group focuses on the development of novel human brain-on-a-chip platforms to functionally assess and quantify the responses of advanced central nervous system (CNS) models, consisting of 3D circuits of neurons and supporting astrocytes and microglia cells inside biomimetic 3D scaffolds. The proposed platforms envision to address the need to study how information is processed and propagated by neurons in the human CNS. Our platforms enable the study of disease-specific and patient-specific CNS models by advanced imaging, and electrophysiological, molecular biology and biochemical assays. We firstly focus on human amyotrophic lateral sclerosis (ALS) and demyelinating multiple sclerosis (MS). The platforms will enhance our understanding about brain physiology and pathology of these diseases, and boost the development of novel treatments directly on human neural cells ex vivo. The materials we firstly focus on are silicon, collagen and polymer champers with microfluidics. Femtolaser and crypolymerization technologies are implemented to construct the 3D platforms. The 3D collagen scaffolds are also used to develop neuroimplants for repairing spinal cord injury and brain trauma. Collagen is a human friendly material and effectively hosts neural stem cells, affording de novo neurogenesis ex vivo as well as transplantation in vivo to animal models of spinal cord injury, significantly reversing sensomotor neuron loss and paralysis.