ABSTRACT

Jedlicka, Sabrina S., Ph.D., Purdue University, December 2007. Design and Characterization of Hybrid Peptide Sol-Gel Materials for the Solid-State Induction of Neuronal Differentiation. Major Professor: Jenna L. Rickus.

Cell-based therapeutics are a rapidly growing area of research, with considerable promise in the treatment of neurological diseases. One of the primary limitations to neuronal cell-based devices is the necessity to maintain cells in an immature or undifferentiated state in culture prior to transplantation. In many cases, the undifferentiated cell does not express the desired characteristics for implantation. Biologically functional nanomaterials provide the ability to manipulate the direct extracellular environment surrounding cells; influencing their fate and differentiation path. The ability to engineer the interface between the cells and culture materials provides a repeatable, stable means of directing cells down a specific growth path determined by endogenous signaling pathways. This materials approach to cellular engineering can limit the need for added exogenous growth factors, “feeder” layers, or animal sera, in addition to creating a homogenous cell population for transplantation. In this work, hybrid peptide ormosil materials were developed; designed to mimic the developing mammalian brain during corticogenesis. These materials have been developed to enhance the GABAergic phenotype of P19 embryonic carcinoma cells and immature immortalized neurons. The ability to develop a homogenous, directed cell population has implications in stem cell research, regenerative medicine, cell-based devices and biosensing technology.