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Thin-Film Sol-Gel as Controlled Delivery Platform for Neural Microelectrodes

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ABSTRACT

Long-term efficacy of neural implantation devices is a persisting challenge in neural engineering and rehabilitation. Upon implantation of a neural device, the foreign body response (FBR) is triggered and glial cells form a sheath around the electrode array. This sheath isolates the array from the rest of the brain both mechanically and electrically. Tetramethyl orthosilicate (TMOS), a thin-film polymer, has been shown to not negatively impact the impedance and charge-carrying capacity, as well as offer a controlled delivery method to deliver pharmaceuticals to mitigate inflammation without significant effect to device design. Using an in vitro protein delivery model to analyze the ability of multiple layers of TMOS to be used for protein delivery from both silicon wafers and microelectrodes, we evaluated the release kinetics and surface properties of the coatings. Through the wafer analysis, results reflect that adding a layer of TMOS significantly lowered 'burst release' of the protein, bovine serum albumin (BSA). Coating wafer with freshly-made TMOS prolonged the protein release period. Total protein released per number of coats had no linear correlation, possibly due to nonuniform thickness of coats or protein trapped between multiple layers. From these findings, we speculate the possibility of a gradual release model for the utility of TMOS-coated microelectrodes in neural devices.

KEYWORDS

controlled delivery, neural devices, microelectrode, thin-film sol gel, protein release

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