**Nano-structured Silicon Implants for Fighting Breast Cancer**

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In recent years, meso-porous Silicon (PSi) has emerged as a promising and versatile biomaterial for medical applications - notably controlled release drug delivery. PSi exhibits several properties that make it an attractive platform for drug delivery applications: Its electrochemical synthesis allows construction of tailored pore sizes and volumes that are controllable from the scale of nanometers to microns; the surface chemistry of PSi can be easily modified to produce surfaces favorable for drug adsorption and entrapment; PSi biocompatibility was demonstrated, and its biodegradability can be tuned to control drug release kinetics. In addition, PSi is an advantageous platform for cancer therapy, owing to its significant versatility as a hosting material for chemotherapeutic drugs.

Our work aims to develop new PSi-based nanostructures for delivering anticancer drugs. We focus on engineering the PSi nanostructure and its surface chemistry to control the loading and release of Mitoxantrone (MTX, a model anticancer drug). Different PSi films are prepared by electrochemical anodization of Si in hydrofluoric acid solutions. Etching conditions are adjusted to optimize the PSi nanostructure to maximize the drug loading. We find that PSi films are characterized by interconnecting cylindrical pores ranging in diameter from 5-10 nm, an average thickness of 2.3 µm, and porosity of 64% are optimal for MTX loading. Following electrochemical fabrication, the films are chemically modified by thermal hydrosilylation (with 1-dodecene or undecylenic acid), and the drug payload is incorporated within the porous nanostructure. Two loading routes are explored: (i) physical adsorption, and (ii) covalent attachment of the drug. Significant differences in drug release profiles are found between the dodecene-modified PSi and freshly-etched samples. Thus, by changing the surface properties of the PSi from moderately hydrophilic to hydrophobic, the release of MTX can be slowed by a factor of 20. The undecylenic acid-modified PSi samples exhibit different drug release rates due to the conjugation of the drug to the carboxylic acid-functionalized PSi via Si-C bonding. The release of MTX is characterized by a two-step mechanism including oxidation followed by dissolution of the Si scaffold. Flow cytometry assays of cell viability confirm that MTX released from the different PSi-loaded systems maintain significant cytotoxic functionality towards MDA-MB231 cancer cell lines.

**Keywords:** Porous Si, drug loading, controlled drug release, cancer therapy, nanotechnology