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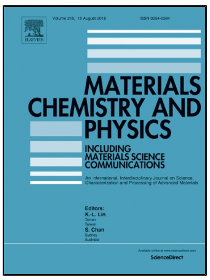


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# Development of amphiphilic block copolymers as silica optical fiber overlayers for BSA protein detection

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**ABSTRACT**
Novel amphiphilic block copolymers having both hydrophobic poly(methyl methacrylate) (PMMA) and hydrophilic poly[2-(dimethylamino)ethyl methacrylate] (PDMAEMA) blocks have been designed and synthesized for efficient protein detection in photonic-based sensing. Both the cationic $PMMA_{117}$-*b*-$PDMAEMA_{16}$ and the cationic vinyl-sulfone functionalized $PMMA_{117}$-*b*-$P(DMAEMA_{17}$-$VSTEMA_2)$ block copolymers were synthesized from a water insoluble hydrophobic PMMA block, which facilitated the formation of stable overlayers on the silica optical fibers surface. The well-defined structure of the co-polymers was confirmed by gel permeation chromatography (GPC). The presence of the cationic PDMAEMA block and the vinyl-sulfone double bonds led to reversible electrostatic binding of negatively charged proteins like bovine serum albumin (BSA) and non-reversible chemical binding by thiol-ene reactions with cysteine in proteins, respectively. The sensing properties of these materials were assessed and confirmed by ATR-FTIR analysis and by the characterization of fabricated sensing heads on silica optical fibers functionalized with suitably deposited overlayers. The sensing assessment revealed the requirements for deposited overlayer characteristics towards proteins' detection sensitivity and selectivity enhancement.

**Keywords:** proteins, polymers, block copolymers, optical fibers, photonic sensors, biosensing

## 1. Introduction

Proteins are a class of major biomolecules that play a crucial role in many areas such as the food industry, biotechnology and medicine. The need for reliable sensing and quantitative control of proteins has fuelled the development of several protein detection methods over the past decades that can provide both sensitivity and selectivity. Due to their monitoring importance a number of different, sophisticated and quite diverse approaches for protein detection have been developed. Aptasensors based on electrochemical interactions have been demonstrated with a high degree of selectivity in the coexistence of other proteins [1, 2]. Furthermore complex techniques like electrochemical impedance spectroscopy based on suitable aptamers as molecular recognition element [3], or monitoring of Atomic Force Microscopy -AFM cantilevers' deflection and bending under electrostatic interactions [4], and Bulk Acoustic Wave (BAW) viscosity sensor [5] were used as protein detection methods. Although some of the aforementioned techniques achieve a high degree of sensitivity, their implementation and use are rather laborious, expensive and require complex interrogation instrumentation setups leading to time consuming processes that in many cases are inapplicable in practical applications.