Subject: Dissertation Defense - Fatema Hashemi, PhD Biosciences
Date: Friday, June 27, 2025 at 8:55:06 AM Eastern Daylight Time
From: SSB Faculty List on behalf of Diane St. Germain
To: SSB-FACULTY-LIST-L@LISTSERV.GMU.EDU

Dissertation Defense Announcement
To: The George Mason University Community

Candidate: Fatema Hashemi

Program: PhD in Biosciences

Date: Thursday July 10, 2025

Time: 10:00 AM Eastern Time (US and Canada)

Location:
In Person – IABR room 1004, Science & Tech campus
And
Virtual via Zoom
Join Zoom Meeting
https://gmu.zoom.us/j/98142320199?pwd=2Kk1xtGUVp1hU0wb8eUbykxntr7SrX.1

Meeting ID: 981 4232 0199
Passcode: 123
One tap mobile
+13017158592,,98142320199#,,,,*123# US (Washington DC)
+12678310333,,98142320199#,,,,*123# US (Philadelphia)

Dial by your location
+1 301 715 8592 US (Washington DC)
+1 267 831 0333 US (Philadelphia)

Committee Chair: Dr. Alessandra Luchini

Committee members: Dr. Lance Liotta, Dr. Barbara Birkaya, Dr. Barney Bishop

Title: Development of an Affinity Biomaterial for Enhanced Blood Pathogen Reduction

Abstract: Ensuring the safety of blood transfusions remains a critical priority in modern medicine, driven by the ongoing risk of transfusion-transmitted infections

(TTIs). This dissertation presents a novel pathogen reduction technology (PRT) based on nylon affinity networks functionalized with synthetic dyes to efficiently capture bacteria in plasma. Nylon filaments were functionalized with a range of dye classes—including acidic, basic, metallic, hydrophobic, and uncharged/polar dyes—to optimize bacterial binding properties. Among the dyes tested, Alcian blue, a phthalocyanine dye with a macrocyclic aromatic structure, demonstrated the highest bacterial capture efficiency against Escherichia coli and Staphylococcus epidermidis spiked in phosphate buffer saline and human plasma.

Quantitative analyses using agar plate assays consistently showed bacterial removal efficiencies of 85–90% for both E. coli and S. epidermidis. The scalability of the approach was validated in a 50 mL system, where a three-step serial incubation protocol utilizing nylon affinity networks achieved complete bacterial depletion in PBS and human plasma. Importantly, post-incubation viability testing revealed that bacteria remained intact on the nylon surfaces without evidence of lysis, effectively mitigating the risk of toxin release into blood products. Alcian blue affinity networks showed minimal human plasma protein adsorption (0.08% of total plasma proteins), thereby validating the selective binding properties of the functionalized nylon. These findings support the robustness, reproducibility, and scalability of nylon affinity networks as a promising platform for blood transfusion safety.

Beyond its immediate application in transfusion medicine, the study explores a conceptual framework where the affinity networks, in conjunction with proteomics studies and gene editing, could reveal mechanistic insights into bacterium-biomaterial interactions. A broader knowledge of bacterial attachment mechanisms and biofilm formation on medical devices such as catheters and implants could inform a molecular based design of biomedical devices.

###