Nitric Oxide-Generating Metallic Surfaces for Enhanced Medical Implants

*Xinyue Zhang, Federico Mazur, and Rona Chandrawati**

School of Chemical Engineering and Australian Centre for Nanomedicine (ACN)
The University of New South Wales
Sydney, NSW, Australia

xinyue.zhang10@student.unsw.edu.au, rona.chandrawati@unsw.edu.au

Medical implants such as catheters, stents, and orthopaedic devices are widely used in clinical applications; however, implant-associated complications, including thrombosis, restenosis, inflammation, and bacterial infection, remain major clinical challenges.[1] Localised nitric oxide (NO) delivery is a promising strategy to address these issues due to NO's antibacterial, vasodilatory, and wound-healing properties.[2] However, achieving stable and localised NO generation directly from implant surfaces remains challenging. Zinc offers a compelling material platform for this purpose, combining NO-generating potential with the advantages of a biodegradable and biologically relevant metal. Although zinc has been explored for biodegradable stent applications[3], its ability to mediate NO generation from endogenous NO donors remains underexplored. Here, we present NO generation from endogenous NO donors such as S-nitrosoglutathione (GSNO) on zinc-based metallic surfaces (Figure 1). Zinc promoted sustained NO release from GSNO, with the response increasing over time and varying with GSNO concentration, demonstrating controllable NO generation. Importantly, NO-generating activity was maintained after repeated use and following pre-incubation in physiologically relevant media. Preliminary biocompatibility studies further supported the biological feasibility of zinc as an NO-generating surface. Our findings highlight the potential of zinc as a biodegradable metallic platform for localised, surface-mediated NO generation in implant applications. Future work will focus on fine-tuning NO-release kinetics under physiologically relevant conditions and evaluating the long-term antibacterial and biological performance of zinc-based NO-generating implant materials, representing essential steps toward clinically relevant infection control and improved patient outcomes.

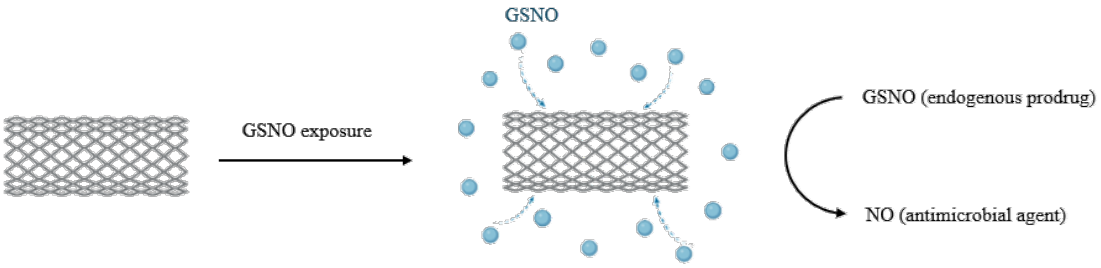

Figure 1: Schematic diagram of zinc-based metallic implants demonstrating catalytic activity towards endogenous prodrug decomposition for nitric oxide generation.

References:

[1] VanEpps. JS.; et al. *Shock* **2016**, *46*, 597-608.
[2] Yang. T.; et al. *Advanced Science* **2018**, *5*, 1701043.
[3] Rao. J.; et al. *ACS Biomater. Sci. Eng.* **2024**, *10,* 5454-5473.