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THE RISING STARS

Women in Engineering Workshop

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Catalytically Nitric Oxide-Generating Materials for Biomedical Applications

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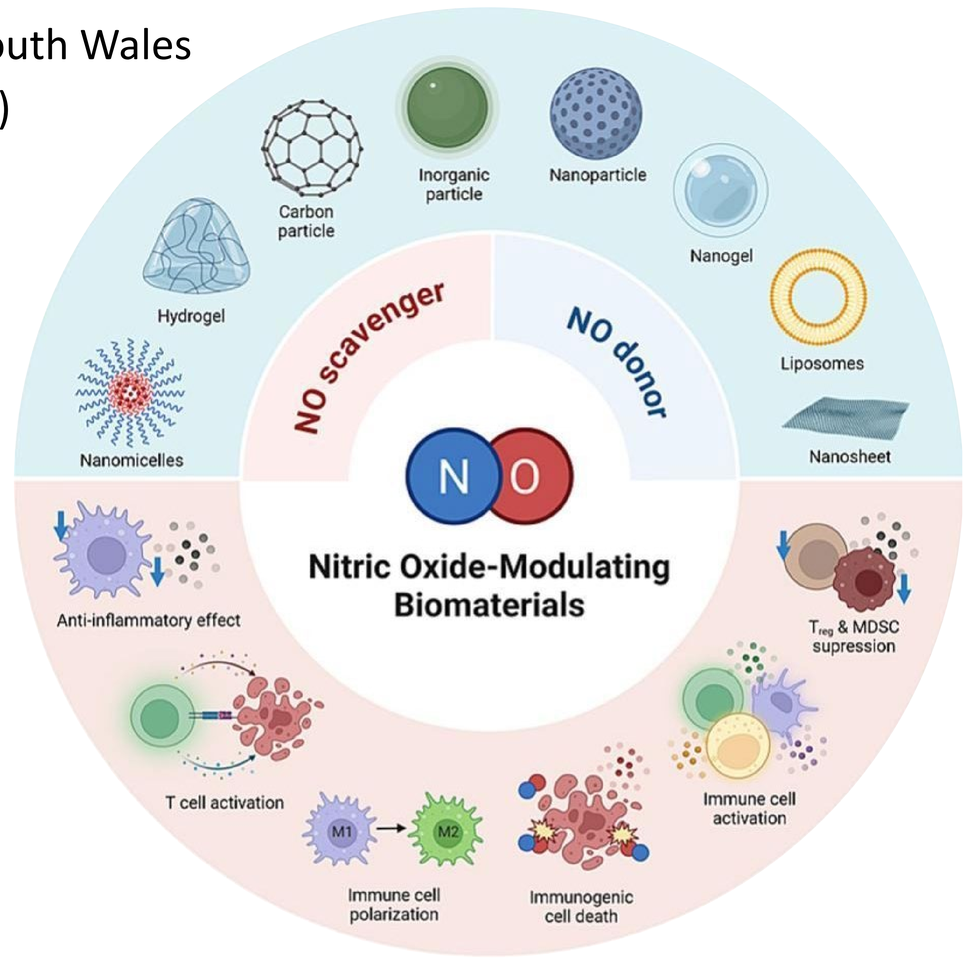


Introduction

Nitric Oxide (NO)

NO is well-known for its regulatory effect on the **cardiovascular system**

- Vasodilation
- Improve blood flow
- Anti-platelet effect
- Reduce inflammation

*NO's effect is **concentration-dependent**:*

- Low/moderate NO levels are generally protective and maintain vascular homeostasis.
- Excessive NO can induce oxidative stress, causing protein damage, lipid peroxidation, and cellular injury.

NO is delivered using nanomaterials via:

- Non-catalytic approach

  Deliver prodrug into the target site

  Spontaneous release/ triggers

  NO

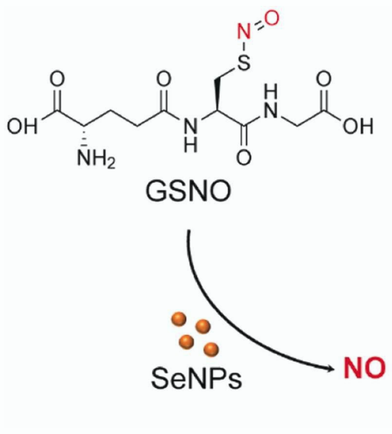
- Catalytic approach

  Endogenous NO donor

  NO

  Deliver nanozyme to the target site

Selenium (Se) for NO Delivery

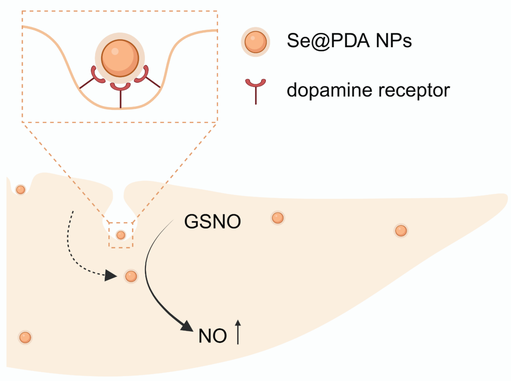


Selenium nanoparticles (SeNPs)

- SeNPs are effective catalyst for NO generation from endogenous NO donors, such as *S*-nitrosoglutathione (GSNO)
- Their effective NO-generating activity are demonstrated through NO-induced biofilm dispersal activity

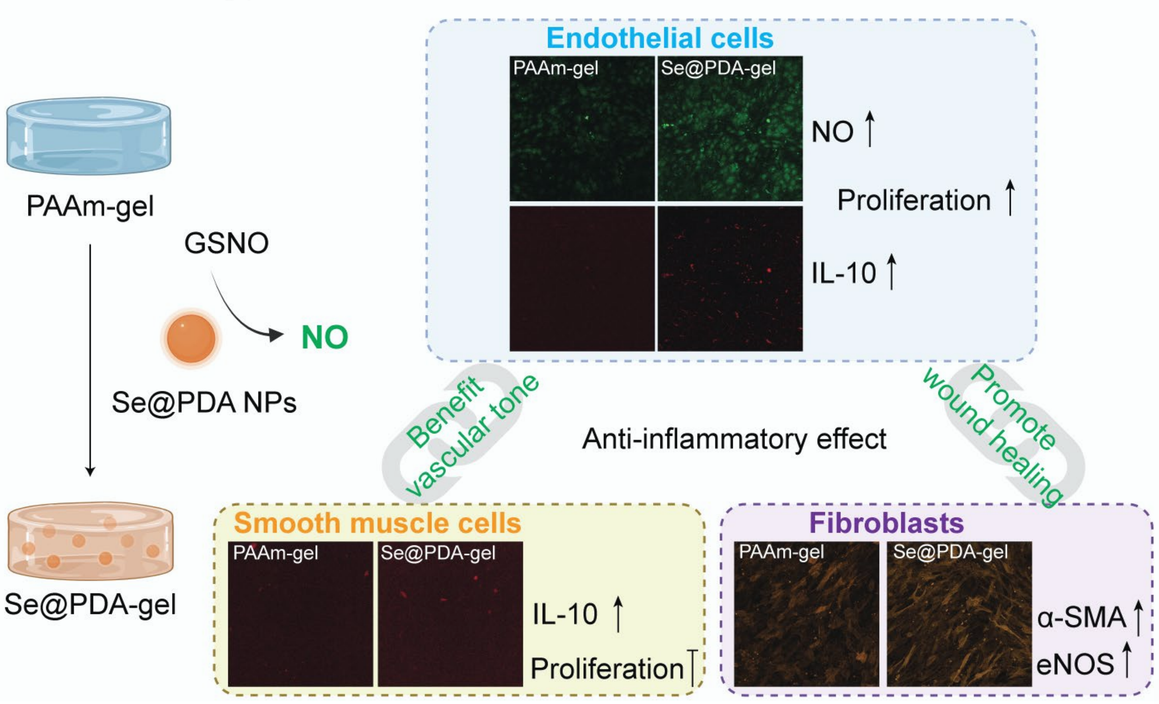
Selenium@polydopamine (Se@PDA) NPs

- Polydopamine coating improves the stability of **Se@PDA NPs** in physiological conditions
- Polydopamine coating enhances cellular uptake of NPs, leading to increased intracellular NO levels



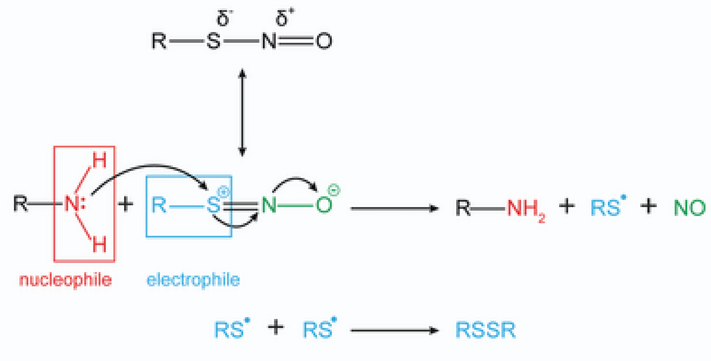
Se@PDA NPs loaded hydrogels

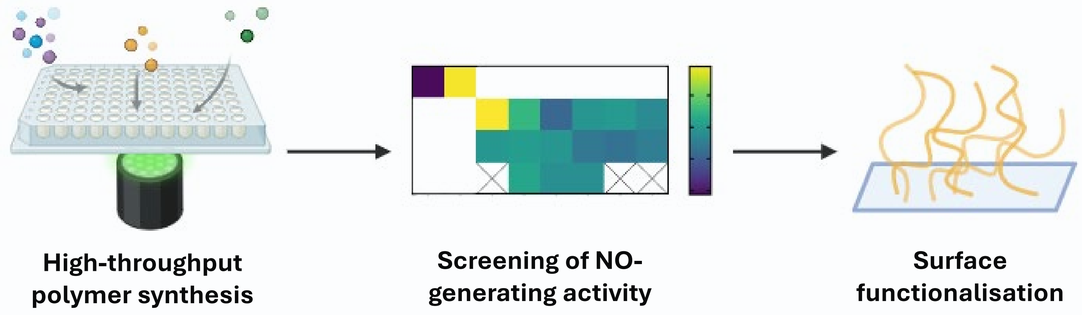
- Se@PDA-gel exhibited anti-inflammatory effects in both HUVECs and HCASMCs, demonstrating their potential in cardiovascular diseases
- Se@PDA-gel upregulated α-SMA expression in NIH 3T3 cells, suggesting their wound healing potential



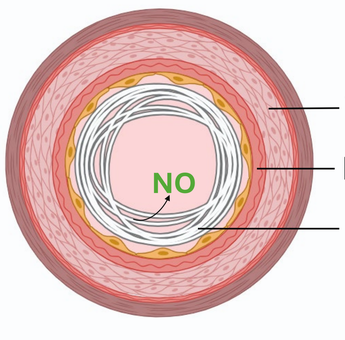
Polymers for NO Delivery

Polymeric amines can induce the decomposition of endogenous NO donor (GSNO) and release NO via nucleophilic attack.





- A library of polymers is synthesised via **PET-RAFT polymerisation**, enabling high-throughput synthesis.
- Their catalytic activity and cellular responses are subsequently screened to identify promising candidates.
- The best-performing candidates are then grafted onto surfaces via surface-initiated PET-RAFT polymerisation.

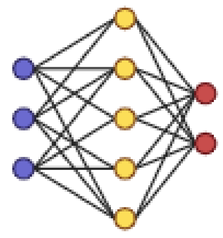


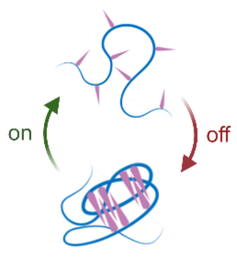
Potential:

- Reduce thrombosis
- Improved endothelisation
- Reduce inflammation

Emerging Opportunities

AI-driven screening:
Use AI to predict polymer structure-activity relationships and accelerate the identification of high-performance NO-generating polymers.





Switchable NO-generating platform
Develop responsive coatings that enable on-demand and controllable NO generation in response to physiological or external stimuli.

Organizers

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