Dual-functional polydopamine spheres for supporting bone regeneration in infected conditions

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Introduction

Bone implant-associated infections remain difficult to treat, as the bone microenvironment limits antibiotic penetration and immune response. Antimicrobial resistance further reduces the efficacy of conventional therapies, highlighting the need for new antibacterial biomaterials. **Polydopamine (PDA)** is a bioinspired polymer with strong adhesion, chemical versatility, and good biocompatibility, and can be functionalized with **antimicrobial peptides (AMPs)**, which provide broad-spectrum antibacterial activity with low resistance potential. This study presents a first step towards peptide-functionalized titanium surfaces by developing PDA-based platforms and evaluating their physico-chemical and biological performance.

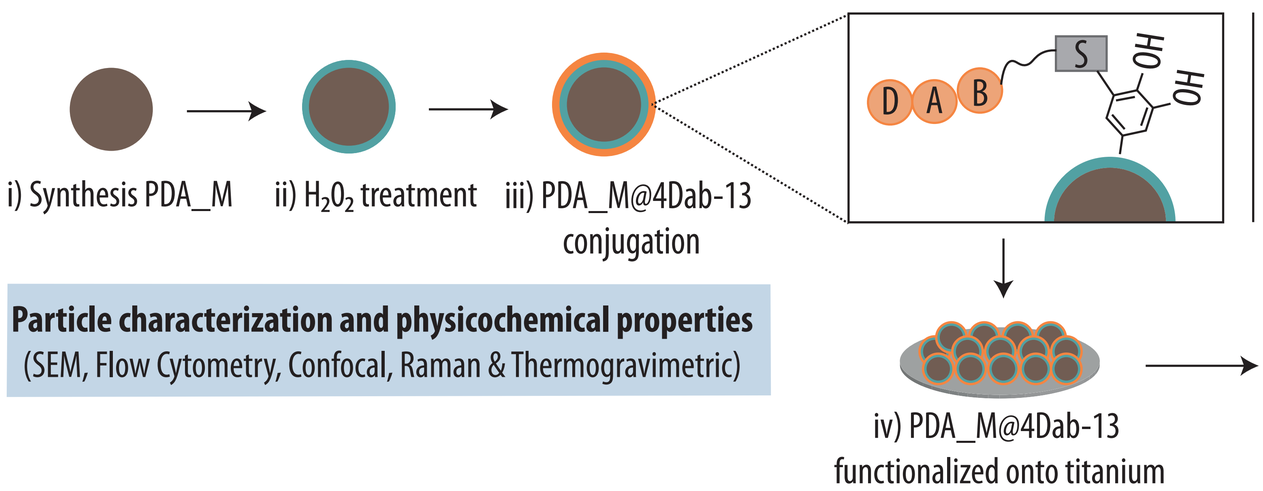
Objectives



Develop and characterize **PDA microspheres (PDA_M)** conjugated with the **novel AMP 4Dab-13**

Assess the antibacterial and cellular response of free **4Dab-13** and PDA_M@**4Dab-13**

Materials and Methods



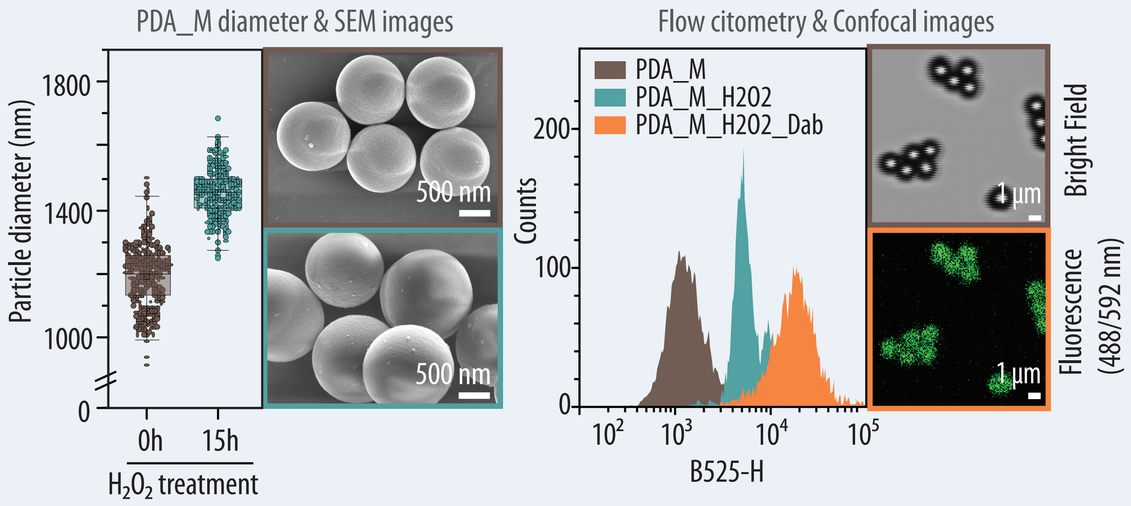
Particle characterization and physicochemical properties
(SEM, Flow Cytometry, Confocal, Raman & Thermogravimetric)

Biological activity of free 4Dab-13
(PA/SA growth curves & SaOS-2 proliferation assay)

Biological activity of functionalized titanium
(antibacterial activity against PA/SA & SaOS-2 proliferation assay)

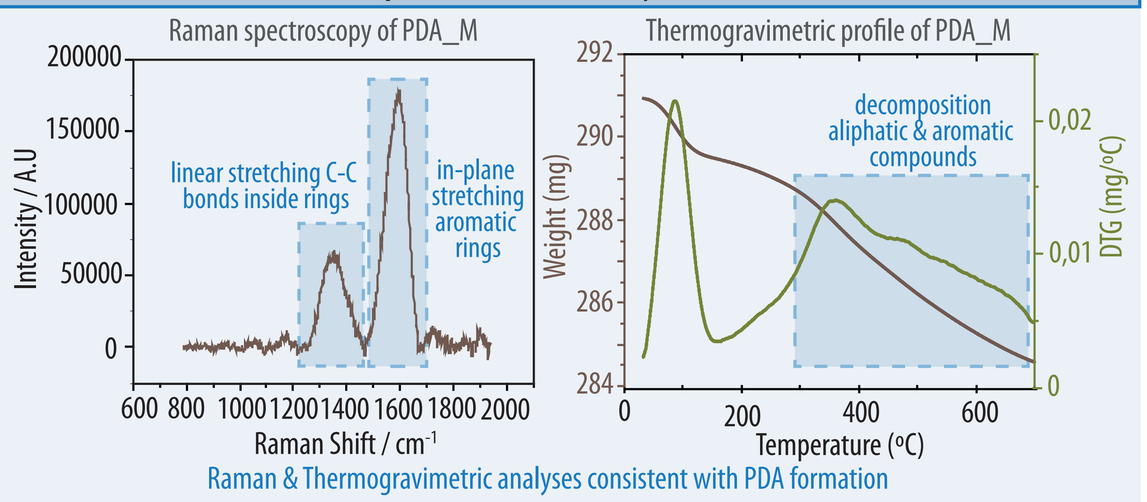
Results and discussion

Particle Characterization



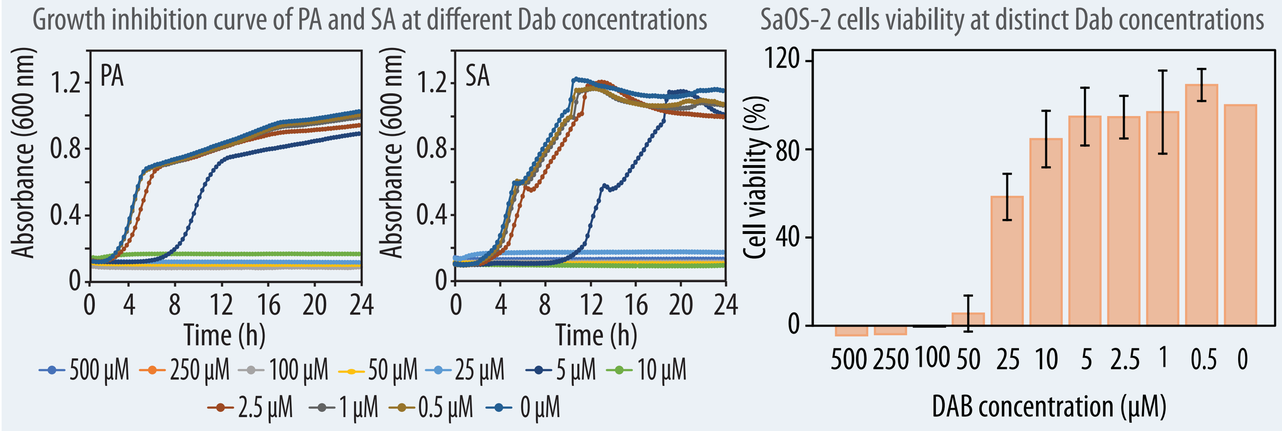
H_2O_2 activation increases particle diameter & PDA_M@4Dab-13 conjugation confirmed by fluorescence shift

Physicochemical Properties



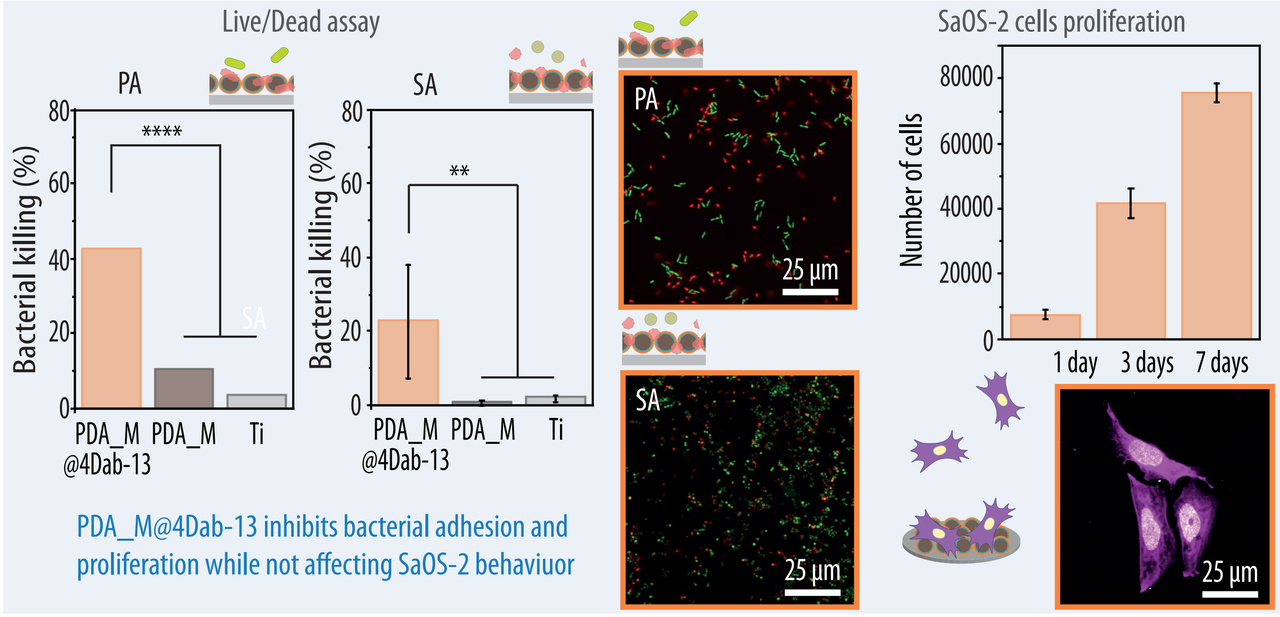
Raman & Thermogravimetric analyses consistent with PDA formation

Biological activity of free 4Dab-13



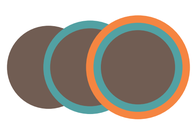
Free 4Dab-13 inhibits bacterial growth while mantaining SaOS-2 viability in a concentration-dependent manner

Biological activity of funtionalized titanium

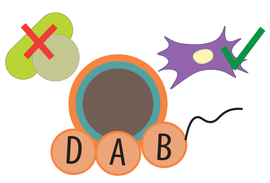


PDA_M@4Dab-13 inhibits bacterial adhesion and proliferation while not affecting SaOS-2 behaviuor

Conclusions



PDA_M successfully **synthesized**, **oxidized**, and **conjugated**



Free 4Dab-13 and functionalized PDA_M@4Dab13 exhibited a**ntibacterial efficacy** while maintaining **cell compatibility**



PDA_M@4Dab13 showed suitable **physicochemical properties** and **efficient titanium functionalization**

Acknowledgments

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References

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(2) Costa, B. et al., , 2021, 10.3390/pharmaceutics13111918
(3) He, X. et al., 2022, 10.1016/j.mtbio.2022.100329

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