Industry Day Theme # Emerging Nano and Advanced Materials

IIT DELHI INDUSTRY DAY 2019

ANTIBACTERIAL RESPONSE OF POLYLACTIDE SURFACES MODIFIED WITH HYDROPHILIC POLYMER BRUSHES

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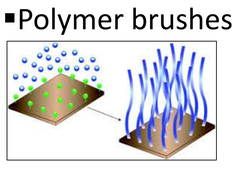
Abstract

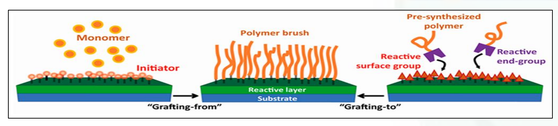
Ultrathin polymeric film on polymer surface may completely change the surface property from bacteria loving to bacteria repelling which would be essential for creating non-fouling surfaces. The covalent modification of biodegradable polylactide (PLA) surface with alkyl bromide initiator followed by immobilization of three different types of polymers having potential antibacterial effects, i.e., Poly (2-hydroxyethyl methacrylate) (PHEMA), Poly(2-[(methacryloyloxy)ethyl]trimethylammonium chloride) (PMETA) and Poly (poly(ethylene glycol) methacrylate) (PPEGMA) were successfully conducted using surface initiated atom transfer radical polymerization (ATRP) technique. High initiator density (1.72 initiator/nm^2) on PLA surface determined by XPS led to the formation of smooth polymer brush as shown by AFM images which were further characterized by FTIR and contact angle. Finally, the antibacterial response of these brushes were evaluated against both gram-positive (*Staphylococcus aureus*) and gram-negative (*Escherichia coli*) bacteria and PMETA modified PLA surface was found to exhibit the highest inhibition of bacterial adhesion (>97% for *Staphylococcus aureus*). The potential uses of these modified surfaces would include biomedical devices, food packaging etc.

Introduction

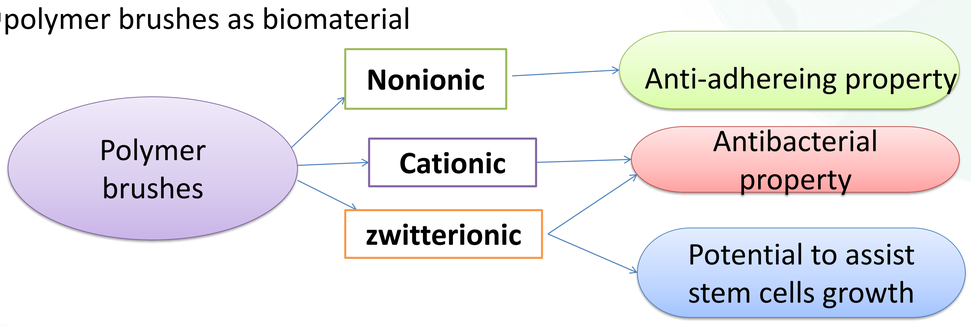
▪Polymer brushes



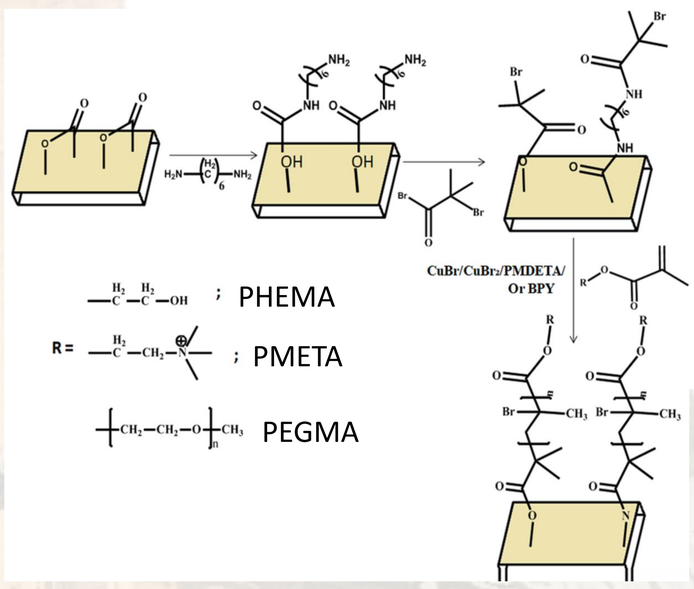
▪Methods to develop polymer brushes



▪polymer brushes as biomaterial



Materials and Methods



Conclusions

- The PLA surfaces were successfully modified with various polyacrylate brushes such as PHEMA, PMETA and PPEGMA using surface initiated ATRP and characterized by XPS, FTIR and AFM.
- The linear growth of polymer brush from PLA surface was found by calculating 'grafting yield' indicating the controlled growth of polymer chains that corroborate well with the mechanism of ATRP.
- A tremendous reduction of adhesion of *Staphylococcus aureus* (>97%) and *Escherichia coli* (>93%) was observed for PMETA modified PLA surfaces due to the presence of quaternary ammonium groups in META.

Industrial Significance

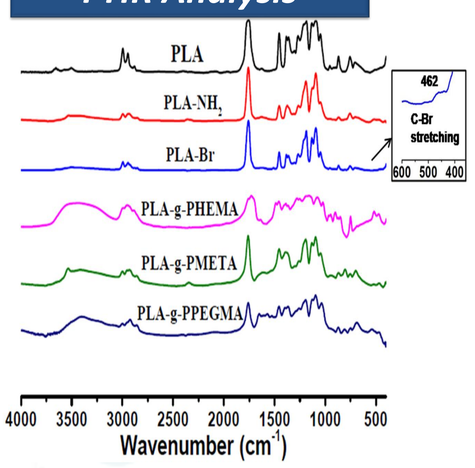
- Non leachable non infective biomedical implant.

Technology Readiness Level:

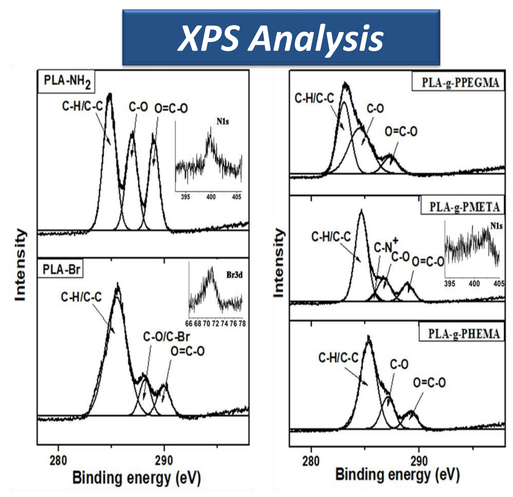
- Working on it.

Result

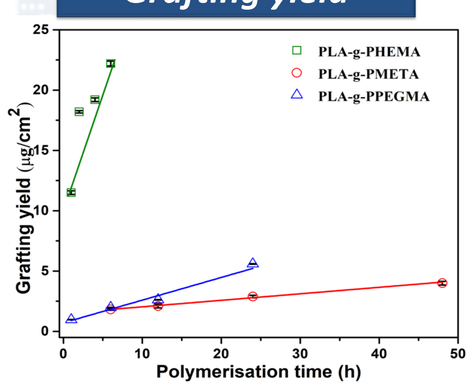
FTIR Analysis



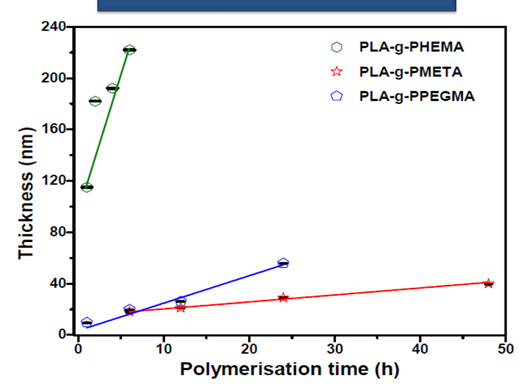
XPS Analysis



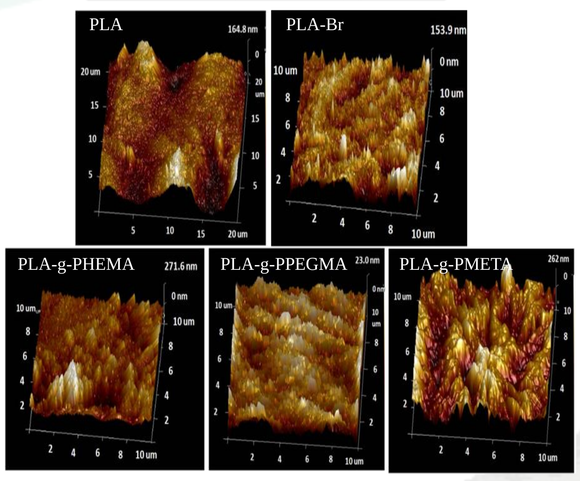
Grafting yield



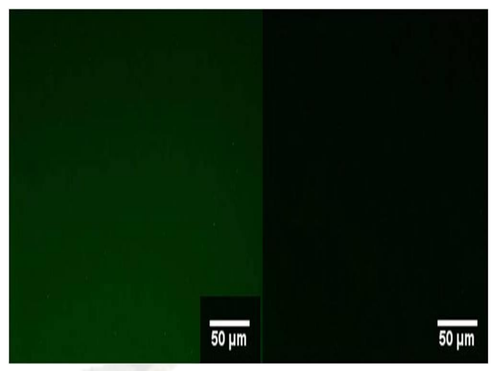
Thickness



AFM Analysis

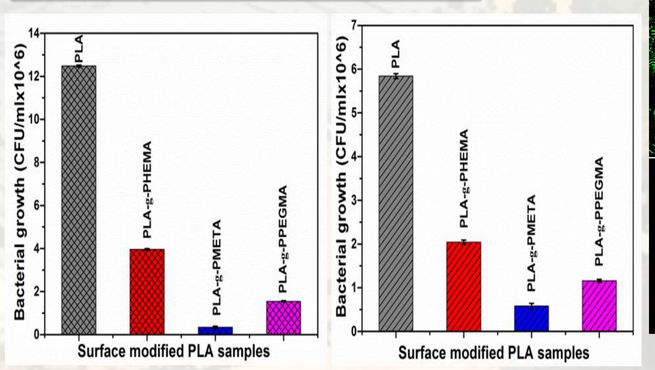


Fluorescence micrograph

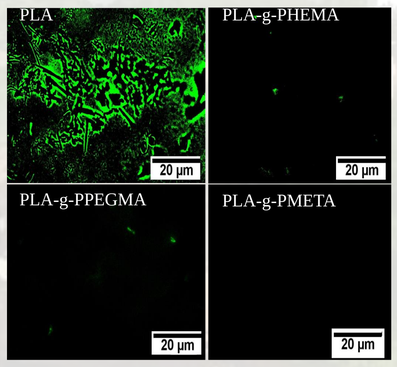


PLA PLA-g-PEGMA

Antimicrobial Activity



E.coli S. aureus



Flourescence images of FDA stained live cells(E.coli)

References

- Verma, M., Biswal, A.K., Dhingra, S. et al. Iran Polym J (2019) 28: 493. https://doi.org/10.1007/s13726-019-00717-3

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