Using Nature's engineering principles to design biointerfaces and synthetic cells for nanomedicine

César Rodriguez-Emmenegger[1,2]

[1]*Institute for Bioengineering of Catalonia (IBEC), Barcelona, Spain,*
[2]*Institució Catalana de Reserca I Estudis Avançats (ICREA), Barcelona, Spain*

crodriguez@ibecbarcelona.eu

Nature achieves unmatched functionality by the self-assembly of (macro)molecular building blocks in a hierarchical manner. All information necessary for the function is encoded at the molecular level. Unraveling such blueprints serves as a powerful paradigm in the bio-inspired synthesis of materials that can seamlessly interface with living matter or perform non-natural functions. In this talk, I will present three examples. Firstly, I will present nanoscale coatings for blood contacting medical devices that not only do not activate coagulation but that can even direct blood to digest deadly thrombi. Such coatings find applications in membrane of oxygenators, hemodialysis, and artificial hearts.[1] Secondly, I will present our concept of Kill&Repel coatings for wound dressings.[2] These coatings combine the synergistic action of in situ assembled polymer brushes with a killing mechanism that is orthogonal to eukaryotic cells. When applied to wound dressings they were able to prevent the colonization from various pathogens. The last part of the talk will focus on the development of "quasi-living therapeutics" which are synthetic cells that exert a therapeutic action by recapitulating some biological function.[3] I will illustrate this with Phagocytic Synthetic Cells (PSC) which engulf and kill bacteria and viruses. The dual mode of action is inspired by phagocytosis. The PSCs have the potential to revolutionize the way we fight infectious diseases caused by antibiotic-resistant germs, which is one of the biggest global threats to our welfare.

References

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Figures

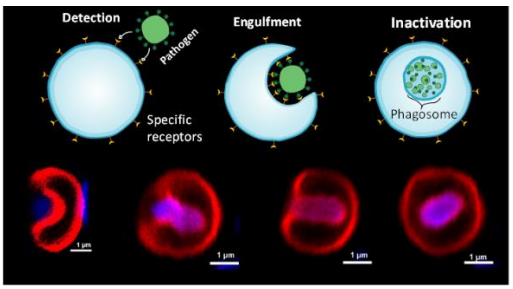

Figure 1. Phagocytic synthetic cells engulfing a living *E. coli* by simple physical interactions.