Genetic code expansion in biosensing and tissue engineering

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Abstract

Genetic code expansion is a robust technology that enables the site-specific modification of proteins theoretically at will, with more than 300 unnatural amino acids. This ability enables the modification of proteins with biorthogonal chemical handles (Nobel Award in Chemistry (2022) was awarded for the development of Biorthogonal Chemistry), biophysical probes, and redox-active amino acids that do not exist in nature as amino acids, among other possibilities. In the past several years we have expanded the genetic code of several microorganisms: *Synechococcus sp. Cyanobacteria, [1] Pseudomonas aeruginosa,[2] Vibrio natriegens, [3] and Chlamydomonas reinhardtii*. Thus, we now have a set of molecular tools that allow us to modify proteins in these microorganisms in addition to doing so in *E. coli*. In those different microorganisms, proteins and enzymes were modified with unnatural amino acids to tether them site-specifically to electrodes to allow direct electron transfer between the enzyme active site and an electrode. [4-8] Enzymes were both oxidative enzymes where the electrons flow to the electrode as well as reducing enzymes where electrons were effectively injected to the enzyme active site. In addition, we use this technology to express novel peptides with incorporated unnatural amino acids that give these peptides novel chemistries, these peptides can serve as scaffolds and adhesive materials in tissue engineering applications. Uses and characterization of these enzymes and peptides will be discussed.

References

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Figures

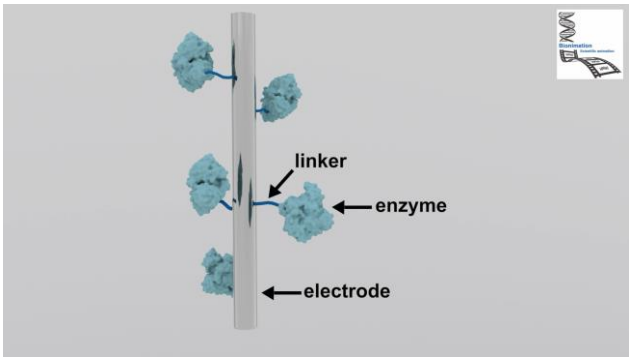

Figure 1. Site-specific wiring and orientation of enzymes to electrodes