Novel Conducting Trimers for In Vivo Electronic Functionalization of Tissues

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Electronic materials that can self-organize in-vivo and form functional components along the tissue of interest can result in seamless integration of the bioelectronic interface. We have designed and synthesized three new trimers based on 3,4-ethylenedioxythiophene (EDOT) and thiophene that can be used as conducting building blocks in bioelectronics.[1] The trimers comprise an EDOT-thiophene-EDOT or an all-EDOT backbone and are functionalized by the addition of side groups that bear anionic or cationic moieties. Functionalizing the side groups with anions or cations proves to be an efficient way to tailor the doping level, as well as the oxidation potential, which consequently affects the polymerization kinetics. In addition, we successfully performed the chemical, electrochemical and enzymatic (in physiological pH) in vitro polymerization of the three trimers. Furthermore, the trimers were efficiently polymerized in vivo along the roots of living plants due to the presence of native peroxidase enzymes. The localization of the resulting polymer in the roots depends on the trimers structure. This work not only offers to the bioelectronics community a set of new water-soluble EDOT-based materials for interfacing living tissue, that complements nicely the currently used ETE-S trimer, but, most importantly, paves the way for rational design of electronic materials that can self-organize in vivo for spatially-controlled electronic functionalization of living tissue.

References

[1] D. Mantione, et al., ACS Appl. Electron. Mater. **2**, 4065 (2020).