Electrospray-deposited polydopamine films for biodegradable supercapacitors

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Polydopamine (PDA) is a highly adhesive polymer that is obtained when dopamine undergoes oxidative polymerization. During the polymerization process, dopamine passes through successive stages of oxidation, involving intermediary molecular species such as dopamine-o-quinone (DQ), aminochrome (DAC), and 5,6-dihydroxyindole (DHI). Molecules like DHI, which PDA incorporates within its structure, can engage in reversible redox reactions, transitioning between hydroquinone, semiquinone, and quinone states giving rise to PDA's electroactivity[1] (Figure 1).

The properties of polydopamine, including its adhesion and conductivity, are significantly influenced by the chosen oxidation method. Alterations to the parameters of the oxidation process, such as the type of oxidant used, pH level, and initial concentration of dopamine, have notable impacts on these properties[2].
In our research, we employ a newly developed copper-assisted oxidation method, which holds particular promise within the field of electrospray deposition. The resulting deposited films are free from salt crystals and display homogeneity throughout their structure. These films, characterized by their favorable electrochemical properties, are subsequently utilized as electrode materials in energy storage devices, with a specific focus on their potential efficacy in biodegradable supercapacitors.

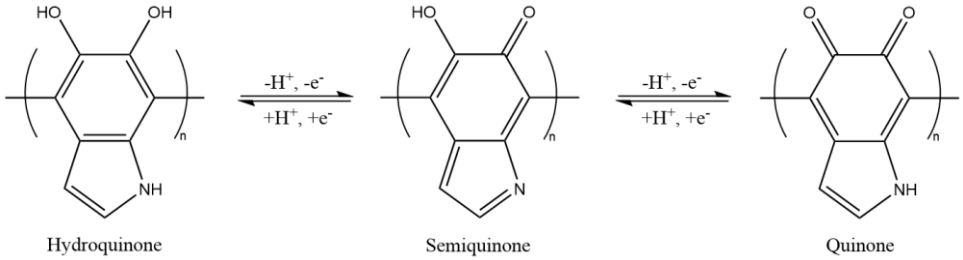

Figure 1: The redox reaction of DHI

References

1 M. L. Terranova and E. Tamburri, *Polymer*, 2021, **229**, 123952.
2 V. Ball, J. Hirtzel, G. Leks, B. Frisch and I. Talon, *Macromolecular Rapid Communications*, 2023, **44**, 2200946.