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ABSTRACT

In this review, we discuss chemical, physical and electrochemical properties of pH-sensitive polymers and organic materials and their sensing mechanisms for healthcare applications. We find that polymers and organic materials, due to their biocompatibility and customizable electrical and electrochemical properties, can be used in pH sensors as structural, pH-sensitive, and passivation materials. To do so, we first identify the properties and sensing mechanisms for pH-sensitive polymers and organic materials. Different functional groups in the materials determine their chemical properties and are involved in redox reactions for chemical sensing of pH. The transport of charge carriers in the polymers and organic materials is influenced by pH-induced electrical field change, which is responsible for physical sensing of pH. Some polymers and organic materials also show hybrid sensing properties, where both functional groups and electrical field-effect contribute to their pH response. Next, we review fabrication technologies for polymers and organic materials, and identify that engineering the materials and new device structures are two possible approaches to improve the sensitivity and reliability of pH sensing devices. We propose that miniaturized sensors can provide enhanced functionality of the sensing materials in constrained spaces. Finally, we present an overview of biocompatible polymers and organic materials for monitoring of pH and pH-related analytes in biological fluids, and for pH-change-triggered drug delivery.

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