

## Dual-ionic pH-sensitive copolymers for hydrogel and versatile biomedical applications

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Controlled delivery of molecules in response to the microenvironment can influence the treatment. We developed a series of dual-ionic pH-sensitive poly(urethane amino sulfamethazine)-based random copolymer for the controlled release of various therapeutic agents. Owing to the unique characteristics of poly(urethane amino sulfamethazine), it exhibited a dual ionic pH-sensitive property in an aqueous solution. At high pH (~pH 8.5), the copolymer exhibited a negative charge and was water soluble due to the presence sulfamethazine groups. On the other hand, at low pH (~pH 5.0), the copolymer transformed to cationic due to the ionization of tertiary amine groups. Interestingly, at the physiological condition (pH 7.4), poly(urethane amino sulfamethazine) copolymer could form a particulate structure and encapsulate protein/drugs effectively via the ionic and hydrophobic interaction between polymer and protein/drugs. The dual-ionic pH-sensitive characteristics of the copolymers were used in the controlled delivery of protein/drugs to treat various intractable diseases.