# Design of soft-biomaterials based on the interfacial water structure for advanced medical devices

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The mechanisms underlying material/protein/cell interactions at the molecular level have not been clearly demonstrated, although many theoretical and experimental efforts have been made to understand these mechanisms [1]. In order to design the appropriate biomaterials, the water structure and dynamics on the materials can be considered. There are two types of water states, namely "*non-freezing*" and "*freezing*" water to form the hydrated materials. It has been reported that the hydrated biomacromolecules such as DNA, RNA, proteins and polysaccharides also formed "*intermediate water"* state in addition to those of *non-freezing* and *freezing* water. The intermediate water is also observed in biocompatible/inert/non-fouling synthetic polymers [2,3], such as poly(2-methoxyethyl acrylate) (PMEA), poly(ethylene glycol), poly(vinylpyrrolidone), polyoxazoline, polyphosphazen, poly(methylvinyl ether), and zwitterionic (betine) polymers which are widely used in the medical field. The intermediate water affects the protein adsorption and cell adhesion, proliferation and differentiation [4-9]. The cell behavior is controlled by the presence of intermediate water and the component of intermediate water against another water state. The molecular structure and dynamics of polymers can dictate the intermediate water contents [10-12]. Using principles of intermediate water, which is common in hydrated biopolymers and only biocompatible synthetic polymers, we found the synthetic methodology to create novel biocompatible polymers moves toward a more high-throughput way. Indeed, new designed aliphatic carbonyl polymers have ester or carbonate linkages facilitating the breakdown of their monomers and thus their degradation. Our group has found that a higher amount of intermediate water in aliphatic carbonyl polymers is related to the blood compatibility/ biodegradability and the presence of the ether bonds in the main chain of the aliphatic carbonyl polymers are involved in the hydration and formation of intermediate water [13]. Such well-defined smart biomaterials could find application in stretchable/flexible and blood compatible electro-devices [14].

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