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Hydrogel lenses functionalized with surface-immobilized PEG layers for reduction of protein adsorption

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The development of antifouling materials is of great interest for multiple biomedical and biotechnological applications, including medical implants, contact lenses, biosensors, drug delivery, and catheters. Surface coating and modification methods that utilize antifouling polymers include physical adsorption, layer-by-layer (LbL), self-assembled monolayers (SAMs), surface initiated atom transfer radical polymerization (ATRP), interpenetrating polymer network (IPN), and reaction of the specific groups of polymers with the substrate. Polyhydrophilic polymers, including polyethyleneglycol (PEG), polysaccharides, and polyamides, and polyzwitterionic polymers such as 2-methacryloyloxylethyl phosphorylcholine (MPC) and carboxybetaine methacrylate (CBMA) have been employed in the development of bio-antifouling substrates to reduce protein adsorption and biofilm formation on contact lenses [1]. In order of Protein-resistant coatings on contact lenses, the novel tri-branched PEG-substituted hydrazides were designed and synthesized for surface modification of poly(2-hydroxyethyl methacrylate) (pHEMA)-based hydrogels.

We have synthesized a novel tri-branched PEG-substituted hydrazide, which imparts densely packed, covalently bound PEG-layers on hydrogels, to determine whether branching provides improved coverage of the lens surface, thereby reducing protein adsorption. The effect of PEG-immobilization on the wettability, surface properties, protein adsorption, and optical transmittance of the resultant hydrogels was investigated, with a particular focus on the branching of PEGs compared to the linear PEG-coated hydrogels and unmodified control. Notably, the amount of protein adsorbed on tri-branched PEG-coated hydrogels decreased significantly, compared to the amount adsorbed onto the surface of control and linear PEG-coated hydrogels. These results provide insight into the mechanism by which PEGs reduce protein adsorption and suggest that PEG-coating may offer an intriguing potential for ophthalmic biomaterials, as well as protein-resistant devices.

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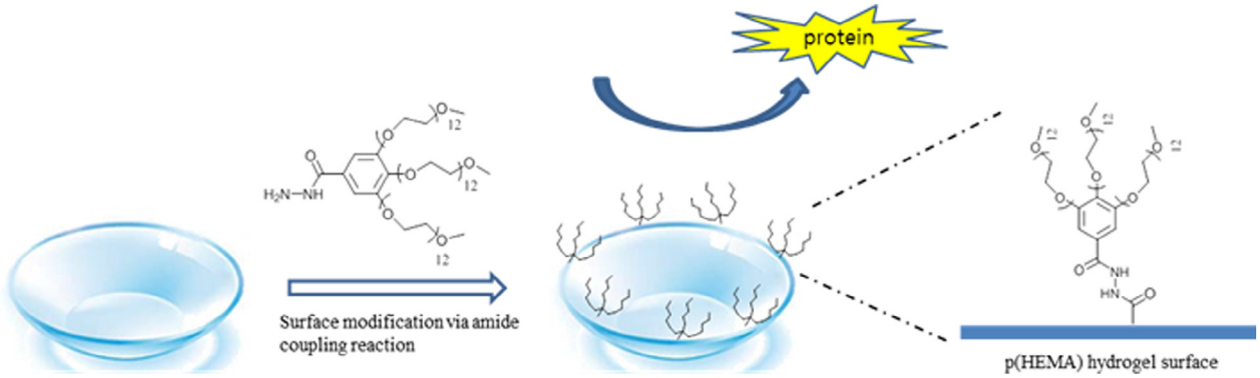

Fig. 1– Schematic representation of branched PEG-functionalized hydrogel lenses exhibiting protein adsorption resistance.

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