

Visible light-triggered living polymerization for creating antifouling and bioactive surfaces

Andriy Kuzmyn, Ai T. Nguyen, Lucas W. Teunissen, Jacob Baggerman, Han Zuilhof

Organic Chemistry, Department of Agrotechnology and Food Science,
Wageningen University & Research

The visible light-triggered polymerization provides a new approach for creating antifouling polymer brushes. We have explored two methods for the creation of antifouling polymer brushes. In the first approach, hierarchical bioactive surfaces are formed by visible-light-induced surface-initiated living radical polymerization employing tris[2-phenylpyridinato-C₂,N]iridium(III) as a photocatalyst. The hierarchical antifouling diblock copolymer structures consist of N-(2-hydroxypropyl)-methacrylamide (first block) and carboxybetaine methacrylate (second block). The second carboxybetaine block of the hierarchical antifouling structures can effectively be biofunctionalized with an anti-fibrinogen antibody. The coated surfaces show a high affinity and specificity to fibrinogen while preventing non-specific adsorption from other proteins in bovine serum. The second approach for the synthesis of antifouling polymer brushes using surface-initiated photoinduced electron transfer–reversible addition-fragmentation chain transfer (SI-PET-RAFT) polymerization with Eosin Y and triethanolamine as catalysts. This method proceeds in an aqueous environment under atmospheric conditions without any prior degassing and without the use of heavy metal catalysts. The versatility of this technique is shown by using three chemically different monomers: oligo(ethylene glycol) methacrylate, N-(2-hydroxypropyl)methacrylamide, and carboxybetaine methacrylamide. Also, the light-triggered nature of the polymerization allows the creation of complex three-dimensional structures. The polymer brushes demonstrate excellent antifouling properties when exposed to single-protein solutions and complex biological matrices such as diluted bovine serum. This method thus presents a new simple approach for the manufacturing of antifouling coatings for biomedical and biotechnological applications.