Nanoparticle coatings for enhanced capture of flowing cells in microtubes

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Abstract

Recently, we demonstrated a flow-based selectin-dependent method for the capture and enrichment of specific types of cells (CD34+ hematopoetic stem and progenitor cells and Human Leukemia HL60) from peripheral blood.[1,2,3] However these devices depend on a monolayer of selectin protein which has been shown to have a maximum binding efficiency as a function of surface area. We have designed a novel surface coating of colloidal silica nanoparticles (average particle dia. 12 nm, 30% by weight SiO_2) that alter surface roughness resulting in increased surface area. The nanoparticles were adhered using either an inorganic titanate resinous coating or an organic polymer of poly-L-lysine. Using Alexa Fluor 647 conjugated P-selectin we found an increased protein adhesion of up to 35% when compared to control. During profusion experiments using P-selectin coated microtubes we observed increased cell capture and greatly decreased rolling velocity at equivalent protein concentration compared to control. Atomic force microscopy showed increased surface roughness consistent with the nanoparticles mean diameter, suggesting a monolayer of particles. Our results show that nanoscale surface topography has significant effects on cell behavior.[4] We believe that this coating has potential to improve existing cell capture implantable devices for a variety of therapeutic and scientific uses.