Creation of Superhydrophobic textiles by surface modification with nanoparticles and long chain alkylalkoxysilanes

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Nanotechnology opens a wide spectrum for enhanced functional capabilities of textile surfaces such as excellent water repellency coined as superhydrophobicity [1]. A surface having a water contact angle $\geq 150^\circ$ and tilt angle $\leq 10^\circ$ is considered to be nonwetable superhydrophobic surface boundary. The superhydrophobicity of a textile surface depends on both surface chemistry and surface topology as previously reported in the literature [2]. Two distinct theoretical models (Wenzel and Cassie-Baxter) have been extensively used to guide the generation of superhydrophobic surfaces by either roughening the surface, lowering the surface free energy, or both [3]. This paper aims to impart superhydrophobicity on inherent flame retardant polyester fabric surfaces through in-situ deposition of SiO_2 nanoparticles prepared by sol gel method followed by surface modification with long chain alkylalkoxysilane. The molar concentration of Silica in Si-nanosol has been varied from 0.025 mol to 0.075 mol and the modifier concentration has also been varied from 7% to 14% (w/w). The textile surfaces thus developed showed water contact angle measured by sessile drop method as 149° and tilt angle as 7° as depicted in Figure 1 and Figure 2, respectively. Dynamic wettability of impacting droplets on the coated samples has been ascertained according to spray test method and thus 100 spray rating number was observed. Figure 3 shows the morphology of nanoparticles coated samples as characterized by scanning electron microscopy and a continuous, properly adhered, a few nm thick coating was observed.

The change in physical and functional properties such as tear strength, air permeability, bending rigidity & flame retardancy of coated and uncoated substrates have also been evaluated. The nanoparticles coating followed by modification shows limited reduction in the tear strength and bending rigidity. The changes observed in the air permeability were negligible and hence did not alter the breathability of the fabric adversely. The flame retardancy of the

coated fabric remains unaffected by the superhydrophobic treatment.

Figure 1: A 10 μL water droplet on coated substrate

Figure 2: Shedding of water droplet from coated substrate at 7° tilt angle

Figure 3: SEM image of (a) 0.025 mol (b) 0.05 mol and (c) 0.075 mol silica nanoparticles coated polyester substrate

References

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