

Functionalization of rayon fiber utilizing titanium oxide photocatalyst

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Titanium oxide photocatalyst is drawing attention as an advanced material of the 21st century. This laboratory prepared a complex with titanium oxide photocatalyst and silica. The complex allowed the photocatalyst to be incorporated into fine rayon fibers. Fibers containing TiO₂ 30 nm in particle size at 5.0wt% or more showed very high antibacterial properties. The rayon fibers containing the photocatalyst were then subjected to photoirradiation to examine the dye degradation effect of photoirradiation. The dye was readily degraded in an aqueous solution. In other words, self-cleaning effect, by which soil disappears spontaneously, can be expected. Furthermore, dye degradation effect was clearly enhanced with increasing amounts of titanium oxide added to rayon fibers.

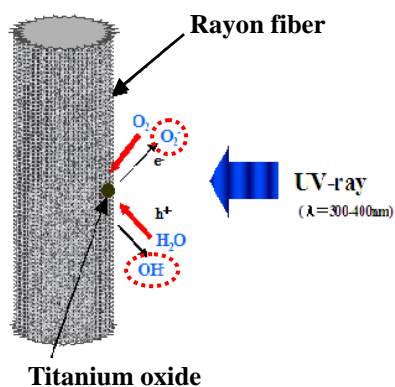


Fig. Antibacterial mechanism of rayon fiber containing TiO₂

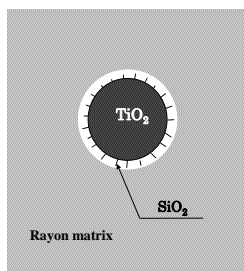


Fig. The structure of titanium oxide coated with silica

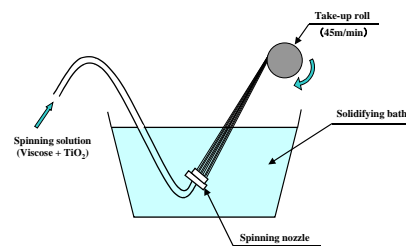


Fig. Schematic representation of wet-spinning devices

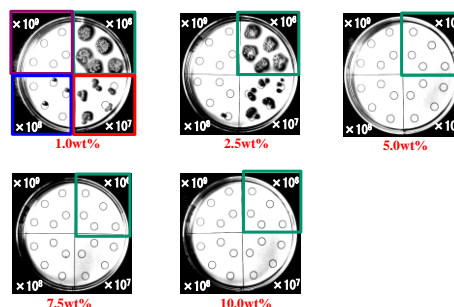


Fig. Comparison in terms of different titanium oxide silica complex contents contained in the 1.7dtx rayon (Particle size: 30nm, SiO₂: 5wt%).

Table Antibacterial test for rayon fibers containing titanium oxide silica complex (TiO₂:30nm, SiO₂:5%)

Sample	Diameter of TiO ₂ particle (nm)	SiO ₂ contents (wt%)	Fineness (dtx)	TiO ₂ content (wt%)	Incubation time (Hr.)	Antibacterial properties		
						Viable bacteria (CFU/ml)	Bacteriostatic activity	Bactericidal activity
Bacteria	—	—	—	—	0	1.24×10 ⁵	—	—
Rayon containing TiO ₂	30	5	1.7	1.0	18	8.80×10 ⁹	-0.08	-4.85
	30	5	1.7	2.5	18	5.52×10 ⁹	0.12	-4.65
	30	5	1.7	5.0	18	ND	9.86	5.09
	30	5	1.7	7.5	18	ND	9.86	5.09
	30	5	1.7	10.0	18	ND	9.86	5.09
Ref) Bacteria	—	—	—	—	18	3.68×10 ⁹	—	—

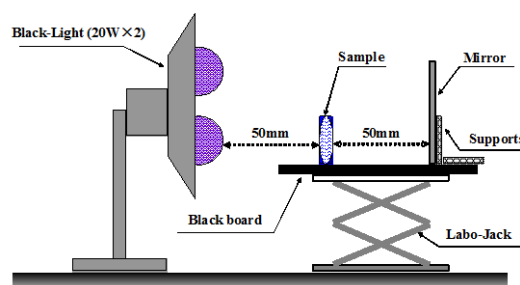


Fig. Schematic representation of the device for UV-irradiation.

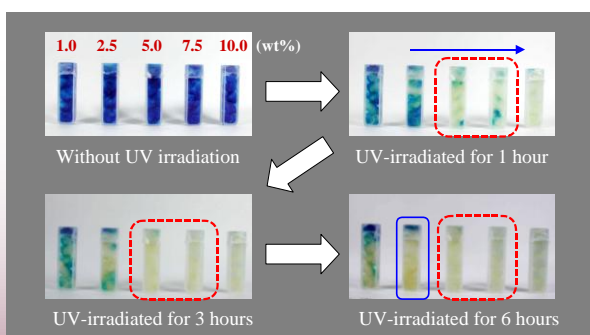


Fig. Rayon fibers dyed with Methylene Blue solution for different TiO₂ contents (The diameter of TiO₂ particle : 30nm).

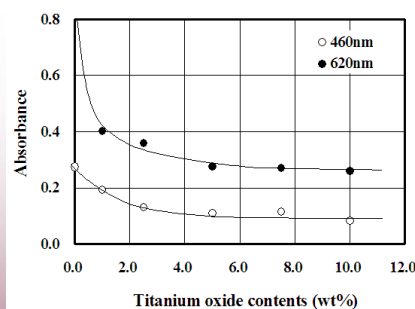


Fig. Relationship between titanium oxide contents in fibers and absorbance of Methylene Blue solution after UV-irradiation.