

Morphological structures and self-cleaning properties of Nano-tio₂ coated cotton yarn at different washing cycles

ABSTRACT

Titanium dioxide (TiO₂) has an extraordinary photocatalytic activity and it effectively provides self-cleaning properties for cotton products. With the presence of succinic acid, it helps the adherence of the TiO₂ nanoparticles on cotton surfaces. However, the ability of succinic acid to keep the TiO₂ adhered on cotton after washing is not yet fully understood. Therefore, this study aimed to investigate the effects of washing cycles on nano-TiO₂ coated cotton yarn with the aid of succinic acid on the morphological structures and self-cleaning properties. In this study, the nano-TiO₂ was synthesized using a hydrothermal method. The cotton yarn was coated with succinic acid and was later dipped in a nano-TiO₂ nanoparticles suspension. The nano-TiO₂ coated yarn samples then underwent the 5th, 10th, 15th, and 20th wash cycles and were tested for morphological structures and self-cleaning. The self-cleaning properties of the nano-TiO₂ coated yarn were determined using the depth of colour stain. The depth of the colour stain was presented as K/S value, where K and S are corresponded to the absorption and scattering coefficients of the stained fabric, respectively. From the analysis, our synthesized nano-TiO₂ had a size of 20–50 nm range with a band gap of 3.06 eV. After coating, the nano-TiO₂ coated cotton yarn changed in its morphological structure at 5th, 10th, 15th, and 20th wash cycles, respectively. At the 20th wash cycle, the weight (%) of the Ti element continued to decrease up to 4.45%, reducing the photocatalytic activity with the K/S value close to the stained yarn, which was about 0.4. The 5th wash cycle maintained a good photocatalytic activity with the K/S value of 0.06 near to the K/S value of the unstained cotton yarn. The presence of succinic acid in the nano-TiO₂ coated cotton yarn provided good self-cleaning properties up to the 15th wash cycle. By undertaking this study, an enhanced cotton property has been developed that will benefit the textile and clothing industry. This nano-TiO₂ coated cotton has potential to be used for daily apparel and sportswear.