Applications of nanosols for textile finishing: flame retardant and antibacterial properties improvement.

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Chemical finishing techniques are extensively used to improve some properties of natural and synthetic fibers and fabrics. A survey of up-to-date literature [1] reveals that different chemicals are commonly used as finishes to improve fabrics performances but, due to the strong pressure for banning harmful chemicals such as halogen-containing flame retardants, various attempts to reduce/replace environmentally and safety questionable chemicals have been made. Furthermore, the choice of the finishing process contributes to influence the industrial closing costs, thus becoming another parameter to be taken into consideration. In recent years the sol-gel process, which leads to the formation of self-assembled (nano) layers on the fiber surface, has remarkably proved its exceptional potential regarding the synthesis of new coatings with a high degree of homogeneity at molecular level and with outstanding physical–chemical properties. Nanosols are colloidal solutions of nanometer-sized particles obtained in aqueous or organic solvents, usually prepared by sol–gel process. The sol-gel technique represents a versatile synthetic route based on a two-step reaction (hydrolysis and condensation), usually starting from (semi) metal alkoxides (e.g. tetraethoxysilane, tetramethoxysilane, titanium tetraisopropoxide), that leads to the formation of completely hybrid inorganic or organic–inorganic coatings at or near room temperature [2,3]. During textile finishing by coating, the nanosol, showing a very high surface area, is able to realize a three-dimensional (3D) network onto the textile surface due to the aggregation of particles and the subsequent evaporation of the solvent.
These coatings are capable to protect the polymer surface by creating a physical barrier acting as insulator, thus improving the ordinary performances of the treated materials. Sol-gel techniques mainly based on alkoxysilane precursors are promising and practical reactant to prepare silica films, due to their low-temperature and cheap processing and because they are suitable to obtain homogeneous films on textile fabrics. The aim of this study was to investigate the flame retardant activity of phosphorous based sol-gel precursor on cotton fabric, evaluating the influence of different nitrogen source chemicals. To this aim, several combinations of phosphorus based silica precursor with N-donors have been chosen and exploited for obtaining hybrid phosphorus-doped silica films on the surface of the cotton fabric [4]. Such sol–gel treatments have shown to produce significant enhancements of both the thermal and thermo-oxidative stability (as assessed by thermogravimetric analysis) and flammability resistance of the fabric samples. At the same time, zinc-based coatings for antibacterial finishing of cotton fabric were successfully synthesized using an innovative sol–gel route in neutral hydro-alcoholic media [5]. The evaluation of treated cotton efficiency against two pathogenic bacteria Staphylococcus aureus and Escherichia coli, even after five cycles of washing, exhibited strong bactericidal activities. As a matter of fact this method shows unquestionable important advantages, such as low-temperature process, neutral reaction media and the formation of an uniform coating on the treated textile fabrics.

References

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