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Preparation of new Si/P/N synergistic flame retardant and its application in cotton fabric

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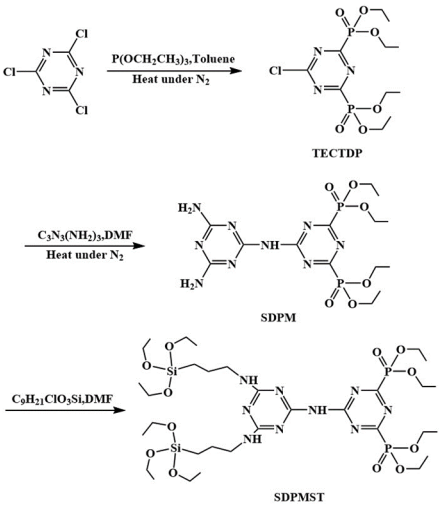

Figure 1. Synthesis process of SDPMST.

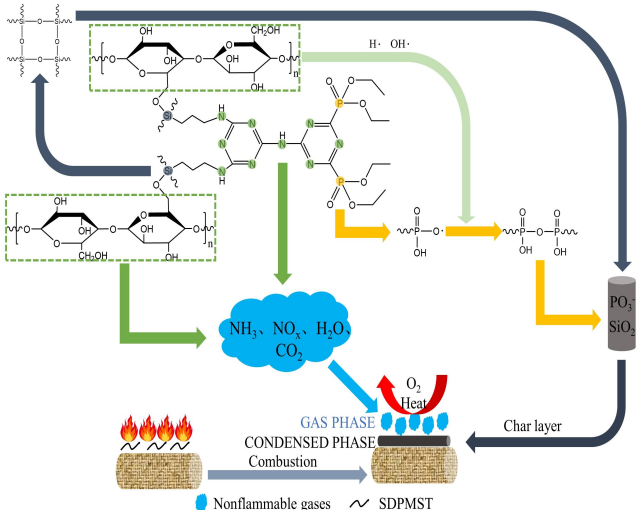

Figure 2. Flame retardant mechanism of the synthesized flame retardant.

Background: As an important natural textile, cotton fabric has the advantages of good moisture absorption, air permeability and comfort. At present, fire still poses a major threat to human life, health and property safety. Considering the flammability of natural textiles, flame retardant modification of cotton fabrics is particularly important, which greatly promotes the development of flame retardant manufacturing industry in the world. Therefore, the research on silicon/phosphorus/nitrogen synergistic flame retardant for cotton fabric has a wide industrial prospect.

Vertical combustion test

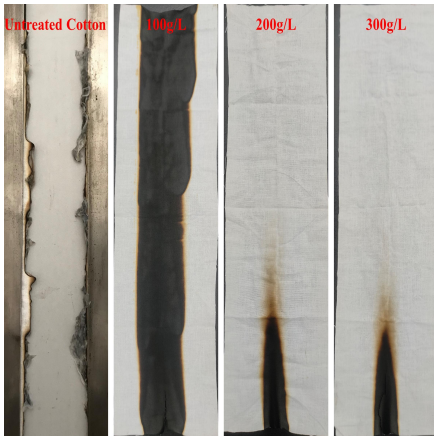

Figure 3. Vertical combustion test of cotton fabric treated with different concentrations of flame retardant.

TG test

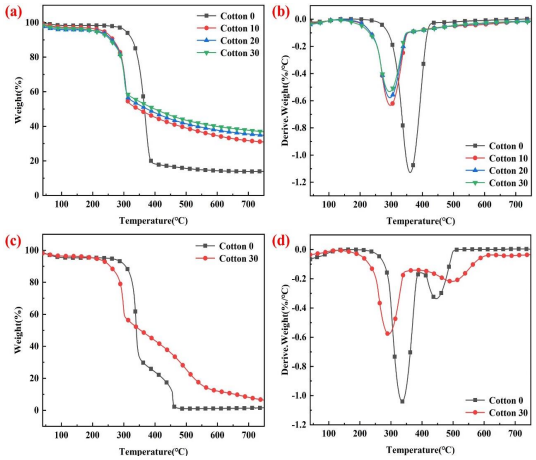

Fig. 4. TG and DTG curves (a, b) of samples in nitrogen atmosphere and TG and DTG curves (c, d) of samples in air atmosphere.

TG-IR test

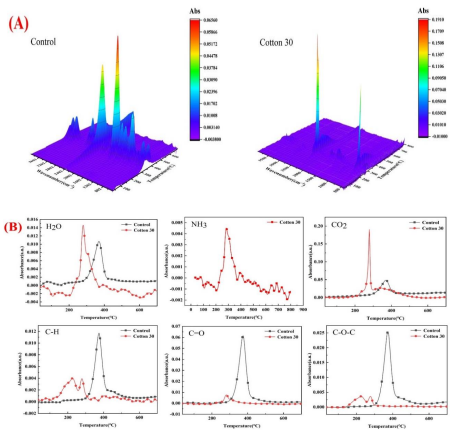

Fig. 5. 3D TG-IR spectra of pure cotton and cotton 30(A); FT-IR spectra of different groups (B).

Cone calorimeter test

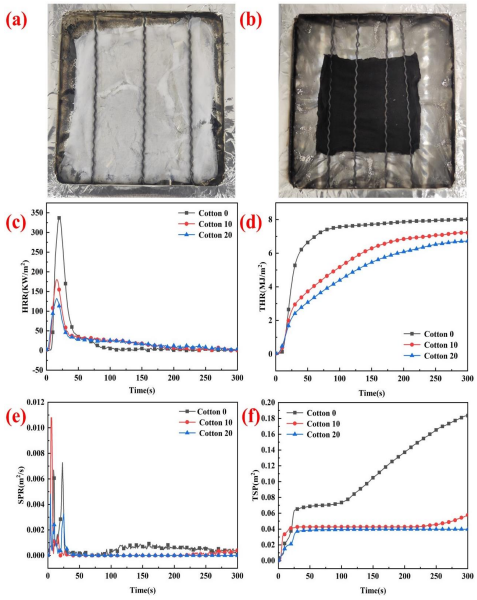

Fig. 6. Digital photos of untreated (a) and treated (b) cotton after cone calorimeter test; HRR(a), THR(b), SPR(c) and TSP(d) curves of the samples.

XPS test

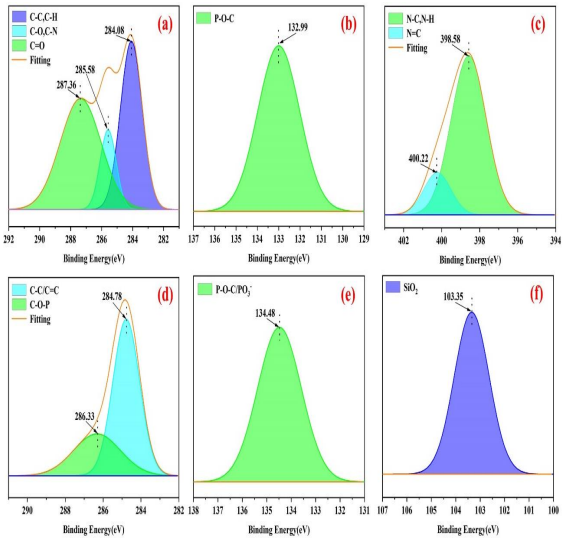

Fig. 7. XPS spectra of C1s, P2p and Si2p of cotton 30 (a, b, c) and cotton 30 after heat treatment at 800℃ for 1 hour (d, e, f).

Conclusion

A new kind of Si/P/N synergistic flame retardant SDPMST was synthesized. When the weight gain was 20.73%, the LOI value was 32.5%, and the length of carbon residue was 6.5cm. The results of thermogravimetric analysis show that the maximum degradation temperature of cotton fabric after treatment has been greatly improved. From the results of smoke emission, it can be seen that SDPMST has the effect of reducing smoke emission at low concentration. To sum up, SDPMST is an efficient and stable flame retardant with good utilization benefits.