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Novel Atmospheric-Pressure Plasma Technology for Treatment of Fibrous Materials: Low-Cost, High-Speed Finishing of Nonwoven Fabrics and Low-Temperature Calcination of Inorganic Submicron Fibers

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The use of nonequilibrium atmospheric-pressure plasmas is emerging as an environmentally attractive alternative for the safe and economical surface treatment of fabrics. Since the growth rates of nonwovens production are extremely high, when compared with the conventional textiles industry, the novel plasma techniques for nonwovens surface hydrophilization are of particular interest, and there is an urgent need for the development of efficient, robust and cost-effective plasma treaters capable of in-line operation in ambient air at 100–1000 m/min nonwovens processing speeds. Standard ”industrial corona” treaters generating highly nonuniform plasma at relatively low plasma power densities require minutes to activate nonwovens, which is too long processing time. A revolutionary plasma sources based on Diffuse Coplanar Surface Barrier Discharge (DCSBD) generating uniform diffuse plasma at atmospheric pressure make possible to reduce the processing times much below 1 sec. The results on high-speed, low-cost hydrophilization of PP nonwovens will be presented to indicate that the DCSBD technology is capable of meeting the basic in-line nonwovens production requirements. An important construction advantage of DCSBD-based devices is that the plasma is generated only in a small volume that roughly equals to the volume of the fabric treated, resulting in reduced power consumption. In the field of textile applications DCSBD plasma has been successfully tested for immobilization of nanoparticles containing the antimicrobial agent on PET nonwoven or improvement of PP nonwoven printing. DCSBD plasma also offers efficient, low-temperature and economic alternative to classical thermal calcination procedure for preparing inorganic submicron fibres (e.g. Al_2O_3, SiO_2, TiO_2). Exposure of organometallic fibres to plasma leads to removal of base polymer and formation of pure submicron fibres what was confirmed by surface diagnostic techniques.

Keywords
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