Abstract

Inorganic submicron fibers have become a subject of increasing interest due to their diverse range of possible applications. Recently, ceramic nanofibers have gained significant attention due to their potential in various fields, including energy harvesting and storage, filtration, insulation, as well as biomedical applications such as tissue engineering and drug delivery. One of the challenges associated with the use of ceramic nanofibers is optimizing their production processes to improve efficiency and enhance their properties. At present, the most commonly utilized approach for the fabrication of ceramic nanofibers involves thermal calcination of electrospun polymer-precursor fibers. Our method involved the use of low-temperature atmospheric pressure plasma to assist in the process by eliminating organic material prior to thermal treatment, resulting in faster calcination at lower temperatures and improving the physical properties of inorganic fibers.

This study investigates the physical and chemical changes that occur in the sample during plasma pretreatment by Diffuse coplanar surface barrier discharge, and examines how these changes affect the final product. In the electrospinning process, polyvinylpyrrolidone was used as the base polymer with zinc acetate and titanium (IV) isopropoxide as precursors. The samples were analyzed using various diagnostic techniques. Chemical analysis was conducted via attenuated total reflectance Fourier transform infrared spectroscopy (ATR-FTIR), energy dispersive spectroscopy, and X-ray photoelectron spectroscopy. Physical properties of the samples were examined by scanning electron microscopy, Brunauer-Emmett-Teller analysis, and X-ray diffraction. The band gap was measured using reflectance spectra and photocatalytic activity by methylene blue degradation. Gas products of plasma treatment were analyzed using Fourier transform infrared spectroscopy.