Surface potential and charges measured by Kelvin probe force microscopy and Zeta potential of polymer fibers and meshes

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Electrospinning is the method that allows to produce nanofibers with desired properties without any other chemical modification. The electric field applied during the process plays a crucial role in determining the surface and bulk properties of fibers by affecting the orientation of functional groups in the polymer chain. Surface potential and surface charge sensing techniques provide the basic information useful in explaining the processes affected on the interfaces, which are closely related to the presence of surface charges. These methods can be categorized into direct potential measurement, such as Kelvin probe force microscopy (KPFM), and indirect method, like the Zeta potential measurement, which is based on electrokinetic measurements.

The KPFM is an essential technique in the field of functional fibers, which find extensive applications in various domains, including smart textiles, sensors, biomedical devices, tissue engineering, and power generation. While surface potential is a crucial feature of these materials, the existing measurement methods primarily cater to ceramic-based materials, posing challenges for the characterization of soft and flexible polymers. With its exceptional lateral spatial resolution and flexibility, KPFM enables the localized measurement of surface potential, making it an ideal tool for investigating polymer fibers.

The Zeta potential is referred to as a parameter for the analysis of solid surfaces on a macroscopic scale and provides information about the surface charge behavior at the interface when this material is in contact with a flowing liquid medium. Zeta potential measurements are commonly used for the characterization of colloidal suspensions and are more and more explored in the study of solid surfaces, however, measuring the fibrous membrane using this technic is still a great challenge. Determining the material's surface charge in the electrolyte solution can provide important information about the presence of functional groups and their chemical reactivity in an environment with a given pH.

In the presented studies, we explore practical approaches for measuring and analyzing surface charges on electrospun polymer fibers. By leveraging the capabilities of KPFM and Zeta potential measurement, we demonstrate the characterization of these materials with high precision, enabling a deeper understanding of their surface properties. These measurements are critical for chemical, engineering, and biological processes and provide complementary information useful for investigations of the interface phenomena related to the presence of surface charges. These findings contribute to the advancement of functional fibers and pave the way for their diverse applications in numerous fields.

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