

## Custom Electrostatic Probe Diagnostics

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A custom electrostatic probe design for the mapping of surface charge is presented. The coaxial geometry capitalizes on capacitive voltage division, allowing for a simple design and rapid prototyping abilities. Previously a coaxial probe was designed with a 9.4 mm diameter inner conductor to reduce field enhancements to surpass commercially available probe thresholds of +/- 20 kV. Designing the inner conductor to reduce field enhancements that could reach +/- 30 kV at 1 cm distances in air resulted in a reduced resolution compared to commercially available probes when compared directly without post-processing. This work focuses on an updated design where the inner conductor diameter was reduced to 1.6 mm, yielding an improved resolution by a factor of approximately six. The outer conductor was wrapped around the center conductor to keep the field enhancement low, leaving only an  $\sim 0.5$  mm insulating gap between the outer, grounded conductor and the center. This effectively created a hemispherical ending with a 9.4 mm diameter since the potential difference between inner and outer conductors is only on the order of a few volts.

A post-processing procedure using an Inverse Wiener filter, often used in image processing, deconvolves the custom probe's response and regains some of the resolution lost through the necessarily large distance from the charged surface. A COMSOL finite element simulation was used to find the spatial transfer function needed for the post-processing correction. Surface charge mapping was performed for both PTFE and Acrylic, focusing on how charging polarities and different humidities affect charge distribution to determine a relationship between charge decay and unique charge distributions. For instance, using the same triboelectric charging technique for PTFE and Acrylic resulted in negative and positive surface charging, respectively, as expected from the triboelectric series. Across the measured RH humidity range,  $\sim 10$  to 60%, Acrylic had a slower decay rate than PTFE, which may be primarily driven by the initially higher surface potential magnitude observed for PTFE under triboelectric charging.

325 words; 500 allowed.

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