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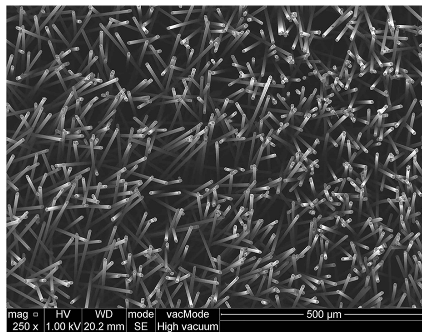
Protecting plasma devices with carbon velvet

Savannah Mandel

Scientists study scanning electron microscopy on carbon velvet to learn how to minimize secondary electron emission.



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The performance of plasma devices can be negatively affected by secondary electron emission (SEE), when electrons are ejected from a surface following energetic bombardment from charged particles. Since SEE can affect the performance and reduce the lifetime of plasma devices, scientists are looking to minimize the effect by engineering metamaterials with specific surface textures.

Ottaviano et al. measured the SEE of a carbon velvet surface using scanning electron microscopy (SEM), which allowed them to simultaneously evaluate both the geometric properties of the surface and its SEE properties, namely its morphological features and SEE yield.

“Previous methods for measuring SEE require complex dedicated laboratory setups which measure the current going to a sample surface and the current emitted from the sample surface to calculate the total SEE yield,” said author Angelica Ottaviano. “Our method is faster, less costly and more localized than conventional methods.”

The authors identified trends in SEE yield related to the length of the carbon velvet fiber, fiber packing density, and fiber orientation. Their method allowed them to capture previously unknown details about surfaces with complex geometries and irregular, non-uniform features.

“This research is beneficial to developing plasma-facing components for electric propulsion thrusters, magnetic confinement fusion devices, plasma processing devices, particle accelerators or any device where it is important to know the SEE properties of the confining materials,” said Ottaviano.

In the future the authors intend on expanding this research to examine the SEE properties of other complex surfaces typically used as plasma-facing components.

Source: “A rapid technique for the determination of secondary electron emission yield from complex surfaces,” by Angelica Ottaviano, Sankha Banerjee, and Yevgeny Raitses, *Journal of Applied Physics* (2019). The article can be accessed at https://doi.org/10.1063/1.5114836.

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