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Carbon velvet trumps graphite for plasma devices by trapping electrons FREE

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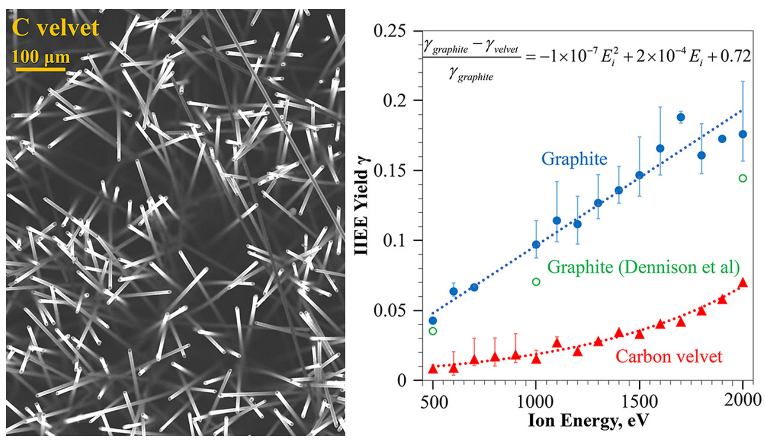
Texturing the carbon used in the walls of high-energy ion applications, such as plasma chambers, reduces ion-induced electron emission.



The efficacy of plasma propulsion and thermonuclear fusion power is affected by, among other factors, the material of the walls facing the plasma. Electron emission from these walls due to incident particles can increase the energy loss to the walls and decrease the energy of the plasma bulk.

While the main source of energy loss is secondary electron emission, ion-induced electron emission also increases energy loss. Research has shown that texturing or roughening the wall materials can reduce this loss, with one type of this texturing referred to as velveting: the addition of nanometer- to millimeter-sized, high-aspect ratio vertical fibers to the material surface.

In *Applied Physics Letters,* Patino et al. report that carbon velvet reduces ion-induced electron emission by over 50 percent when compared with graphite. They measured the ion-induced electron emission from xenon atoms incident on both graphite and carbon velvet, using an ion beam facility at the Jet Propulsion Laboratory.

They varied the incident ion energies from 500 to 2000 electron volts and found the carbon velvet reduced the ion-induced electron emission by 60-85 percent compared to their measurements of emission from graphite. Additionally, the reduction from carbon velvet was higher for ion-induced electron emission than the reduction in secondary electron emission.

The authors postulated that the reduction of emitted electrons occurs due to trapping of the electrons by the velvet's fibers, as is the case for analytical modeling results for secondary electron emission. They concluded that the reduced emission values should be similar for other ion species besides xenon.

Source: "Electron emission from carbon velvet due to incident xenon ions," by M. I. Patino and R. E. Wirz, *Applied Physics Letters* (2018). The article can be accessed at https://doi.org/10.1063/1.5037200.