The Dawn of a New Generation of High-Brightness Electron Sources

The ultimate performance of some of the most powerful characterization tools including x-ray free electron lasers, ultrafast electron microscopes, and particle accelerators are determined by the ability of their electron sources to emit electrons. This small, yet vital element of these multimillion to multibillion dollar systems, has the potential to be improved greatly; the performance of commonly used electron sources pales in comparison to the theoretical limit due to roughness, disorder, and polycrystallinity. The path to maximally efficient electron sources is thus believed to lie with single-crystal films, where the smoothness, homogeneity, and termination can be controlled at the atomic level. Unfortunately, the most desired materials for electron sources contain highly reactive species like cesium, which has stymied the preparation of single-crystal films of these desired electron sources—until now.

Scientists from NSF's Center for Bright Beams, an NSF-STC, made **use of PARADIM's molecular-beam epitaxy system and expertise in safely handling alkali metals in vacuum** to explore the growth of cesium antimonide (Cs_3Sb) thin films in single-crystal form. The precisely controlled fluxes in combination with important feedback from advanced in-situ characterization tools contributed to the success of this work.

The team, with support from PARADIM researchers, achieved films that display unusually high efficiency at thicknesses as low as 4 nm. These single-crystal films open the door to dramatic brightness enhancements for electron sources via increased efficiency, reduced surface disorder, and the possibility of engineering new photoemission functionality at the level of single atomic layers.

Jared M. Maxson (Cornell University)

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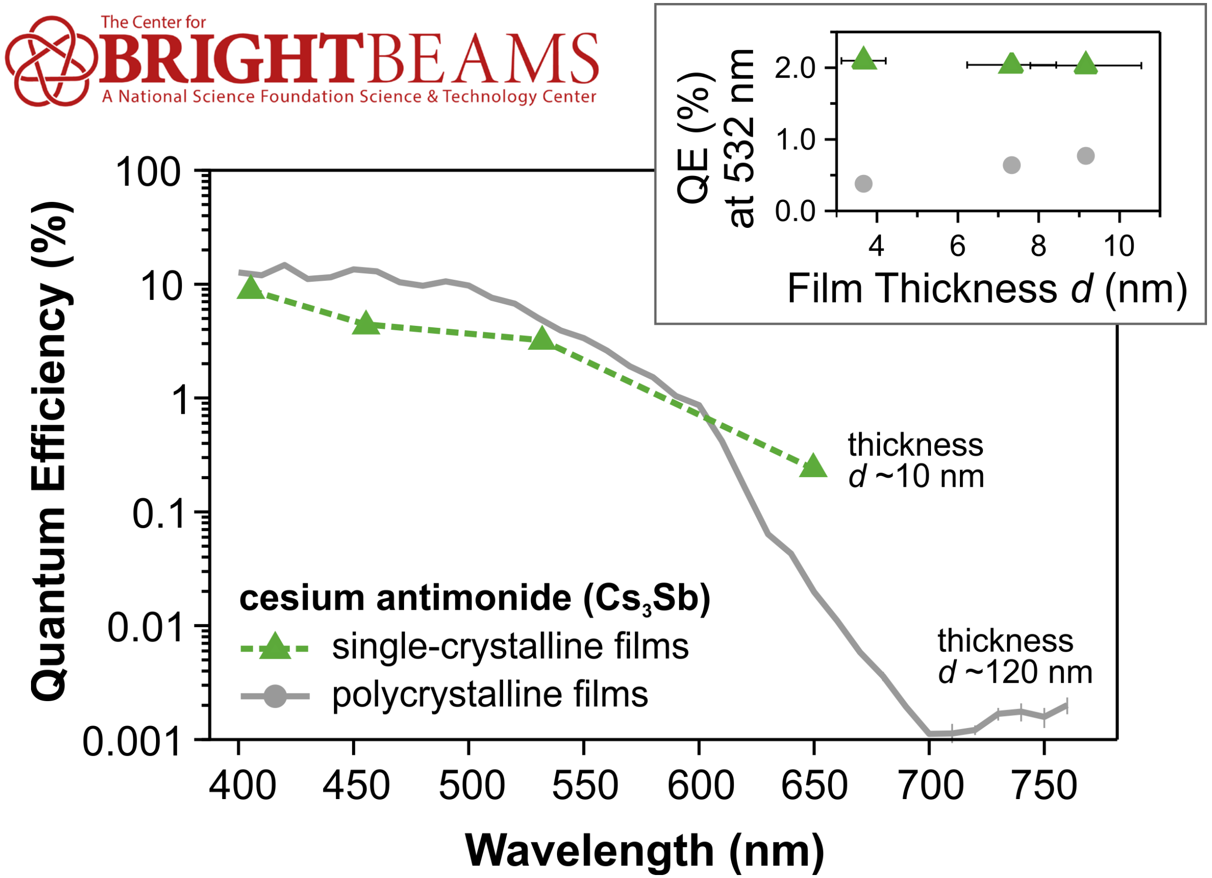

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