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Electron Sheaths and Non-ambipolar Diffusion in Laboratory Plasma[1] SCOTT BAALRUD, NOAH HERSHKOWITZ, Engineering Physics Department, University of Wisconsin-Madison — Electron sheaths were first predicted by Langmuir in 1929 when he stated that, "with a large area, A, an anode sheath is a positive ion sheath, but that as A decreases, a point is reached where the positive ion sheath disappears and it is replaced by an electron sheath."[2] We show that electron sheath formation near a positive anode depends on the anode area, A_a, as well as the area available for ion loss, A_i. When $A_a/A_i < (m_e/m_i)^{1/2}$, the electron sheath potential monotonically decreases from the anode to the bulk plasma. When the anode is larger than this, a potential dip forms in the electron sheath to reduce the electron current lost to the anode. This potential dip is necessary to preserve global current balance and when it is present, total non-ambipolar diffusion can occur where all electrons are lost from the plasma through an electron sheath and all positive ions are lost elsewhere. Additional measurements were carried out to identify the transition from positive (ion) to negative (electron) sheaths. Data were taken in low-pressure argon plasma generated by hot filaments and confined in a multidipole chamber.

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[2]I. Langmuir, Physical Review. **33**, 954 (1929).

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