Electron Attachment Reaction Rates in 2D Atomic Hydrogen-Electron Mixed System on Liquid Helium Surface

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When surface state electrons (SSE) on liquid helium are exposed to a gas of hydrogen atoms (H), electron attachment, $H + e^- \rightarrow H^-$, induces loss of SSE. We measured temperature dependence of electron attachment reaction rates for 0.2–0.6 K in applied magnetic fields 0–5 T. The measured SSE losses are faster at lower temperatures under constant magnetic field. This behavior is qualitatavely reasonable since surface coverage of adsorbed H is large at low temperature and collisions between H and SSE are frequent. However, the reaction is more enhanced than that expected from the collision frequency discussion. The measured reaction rate coefficient K_e is strongly temperature dependent. As the temperature is lowered, measured K_e increases several orders of magnitude within our temperature range. This indicates that some additional factor which enhances electron attachment at low temperature exists. We will discuss microscopic reaction mechanism and interaction between electron and hydrogen atom which is responsible for the reaction.

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