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## Interactions of incident H atoms with metal surfaces

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### Abstract:

Atomic hydrogen is a highly reactive species of interest because of its role in a wide range of applications and technologies. Knowledge about the interactions of incident H atoms on metal surfaces is important for our understanding of many processes such as those occurring in plasma-enhanced catalysis and nuclear fusion in tokamak reactors. Herein we review some of the numerous experimental surface science studies that have focused on the interactions of H atoms that are incident on low-Miller index metal single-crystal surfaces. We briefly summarize the different incident H atom reaction mechanisms and several of the available methods to create H atoms in UHV environments before addressing the key thermodynamic and kinetic data available on metal and modified metal surfaces. Generally, H atoms are very reactive and exhibit high sticking coefficients even on metals where H<sub>2</sub> molecules do not dissociate under UHV conditions. This reactivity is often reduced by adsorbates on the surface, which also create new reaction pathways. Abstraction of surface-bound D(H) adatoms by incident H(D) atoms often occurs by an Eley-Rideal mechanism, while a hot atom mechanism produces structural effects in the abstraction rates and forms homonuclear products. Additionally, incident H atoms can often induce surface reconstructions and populate subsurface and bulk absorption sites. The absorbed H atoms recombine to desorb H<sub>2</sub> at lower temperature and can also exhibit higher subsequent reactivity with adsorbates than surface-bound H adatoms. Incident H atoms, either directly or via sorbed hydrogen species, hydrogenate adsorbed hydrocarbons, sulfur, alkali metals, oxygen, halogens, and other adatoms and small molecules. Thus, H atoms from the gas phase incident on surfaces and adsorbed layers create new reaction channels and products beyond those found from interactions of H<sub>2</sub> molecules. Detailed aspects of the dynamics and energy transfer associated with these interactions and the important applications of hydrogen in plasma processing of semiconductors are beyond the scope of this review.

**Keywords:** hydrogen, Eley-Rideal mechanism, hot atom mechanism, metal surfaces, adsorption, absorption

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