

Wilde研究室

[Hydrogen Absorption at the Atomic Level]

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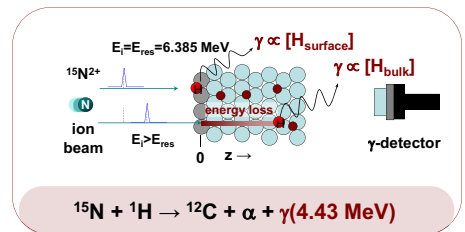
専門分野: 表面ナノ分子物性

工学系研究科物理工学専攻

金属表面における水素吸収過程の原子レベル理解へ

Nanoscale Hydrogen Distribution Analysis near Surfaces and Interfaces

金属内部に吸収された水素は、水素化反応触媒又はクリーンエネルギー源の水素貯蔵技術に関連します。本研究では、白金属単結晶とナノ粒子の表面における水素吸収過程を解明します。

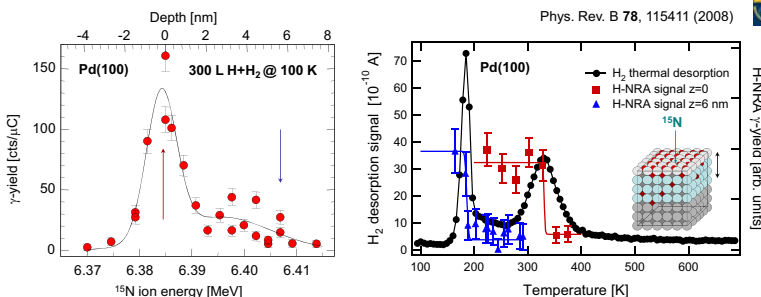


◆ 共鳴核反応法 (Nuclear Reaction Analysis, NRA):

High-Resolution, non-destructive hydrogen depth profiling

- ◆ Real space visualization of H-breathing by metallic nanocrystals and ultra-thin films
- ◆ Distinction of *surface-adsorbed* from '*subsurface*'-absorbed H on nanometer depth scale
- ◆ Thermal stability analysis of absorbed hydrogen
- ◆ Time-resolved measurement of H-uptake kinetics during in-situ H₂ treatments
- ◆ Major Applications:
 - ✓ Hydrogen storage alloys → Atomic level description of H-absorption process
 - ✓ Hydrogenation Catalysts (Pd, Pt) → Role of 'subsurface-absorbed' hydrogen
 - ✓ Relocation Processes of H-Impurities in MOS Devices → Electrical Reliability

Surface/Subsurface-absorbed H distinction at a Pd-single crystal

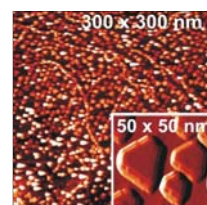


Combined ¹H(¹⁵N, α)¹²C Nuclear Reaction Analysis (NRA) and Thermal Desorption Spectroscopy (TDS) unambiguously identify surface-H and subsurface-absorbed H species.

Oxide-supported Pd-Nanocrystals



Angew. Chem. Int. Ed. 47, 9289 (2008)
Phys. Rev. B 77, 113412 (2008)



4 Å Pd/Al₂O₃/NiAl(110)



Model Hydrogenation Catalyst

First experimental proof for the requirement of **nanocrystal-absorbed hydrogen** in olefin hydrogenation catalysis.

Hydrogen-Relocation Processes in MOS Devices

