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Surface Chemistry of Copper Precursors in Connection with Atomic Layer Deposition (ALD) Processes

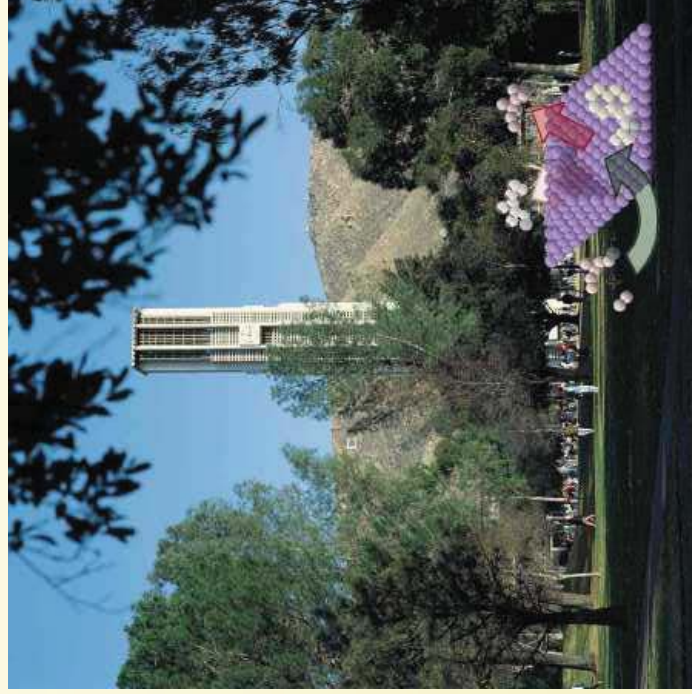
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Surface Chemistry of Copper Precursors in Connection with Atomic Layer Deposition (ALD) Processes



ALD International Conference
Boston, June 28, 2011

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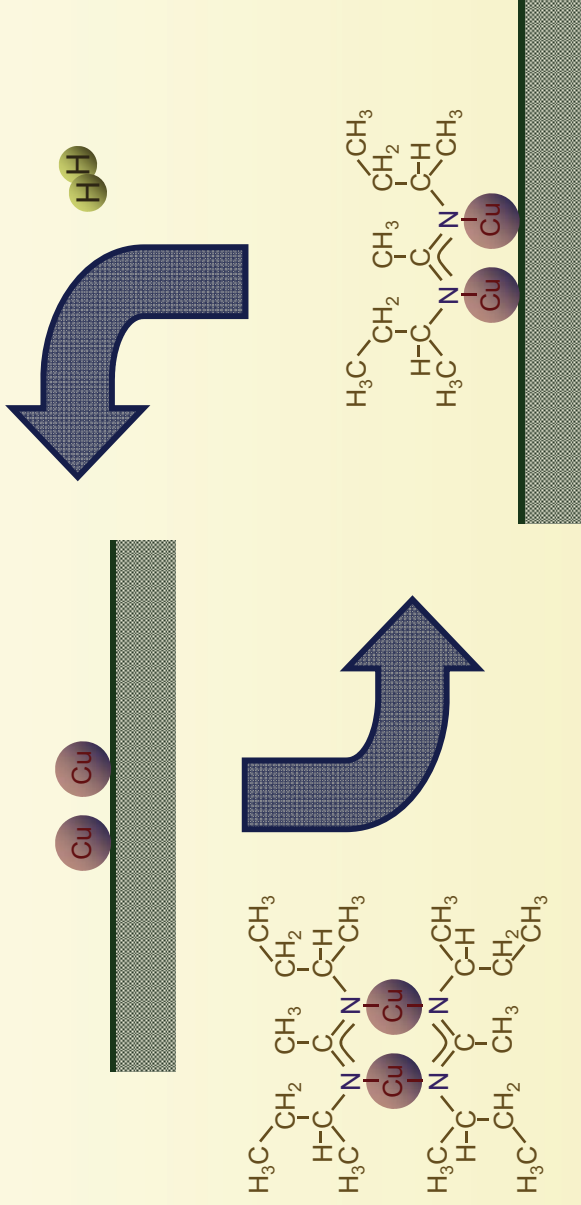


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Introduction

Atomic Layer Deposition

ALD: Separate chemistry into two self-limiting and complementary reactions for more control



Copper Acetamidate: Promising ALD precursor

F. Zaera, *J. Mater. Chem.*, **18**, 3521-3526 (2008).

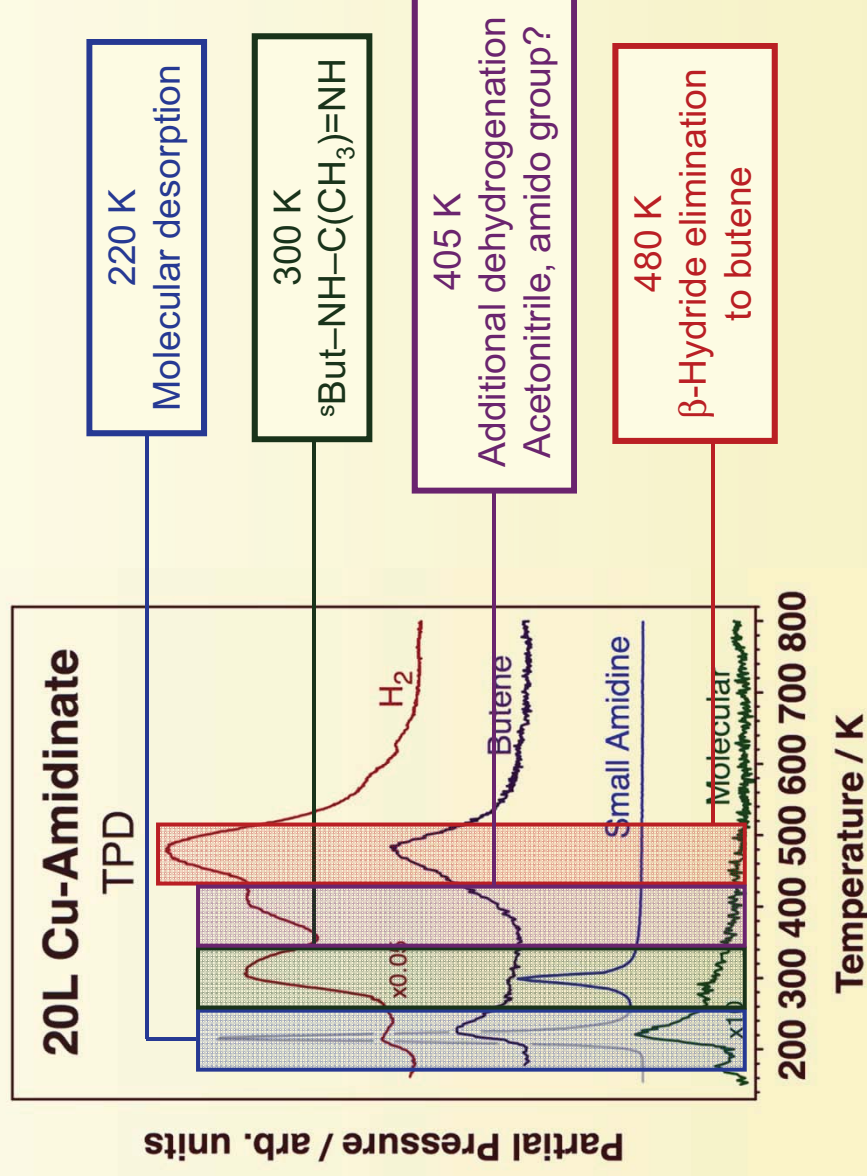
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Cu Amidinate Thermal Chemistry

Stepwise Decomposition, TPD on Ni(110)



Q. Ma, H. Guo, R. G. Gordon, F. Zaera, *Chem. Mater.*, **22**(2), 352–359 (2010).

Q. Ma, H. Guo, R. G. Gordon, F. Zaera, *Chem. Mater.* (2011).

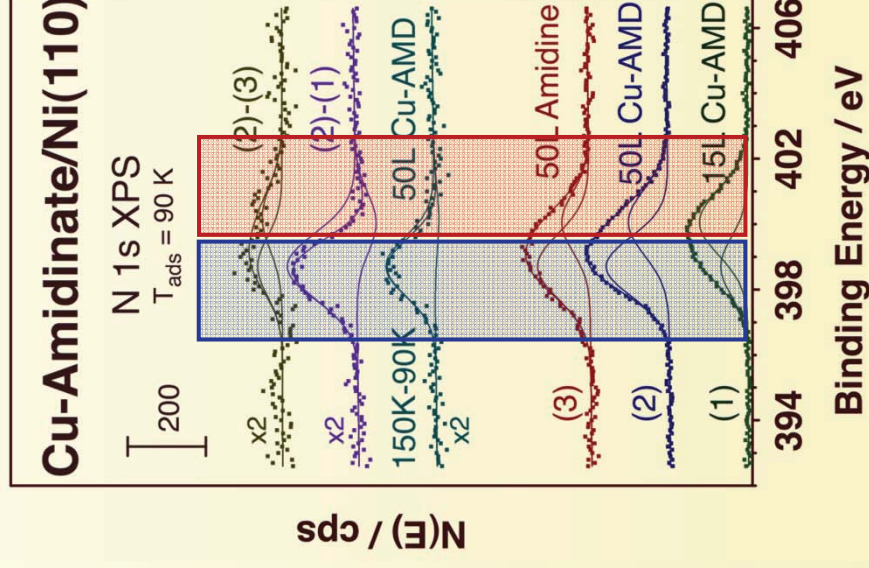
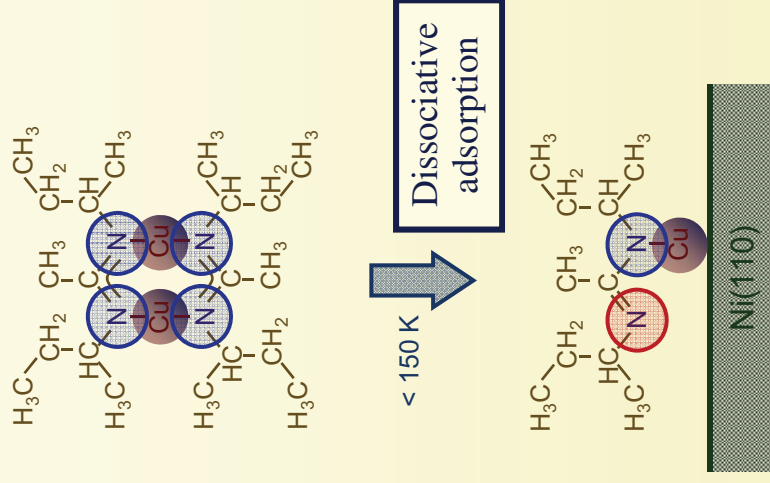


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Dimer Dissociation upon Adsorption



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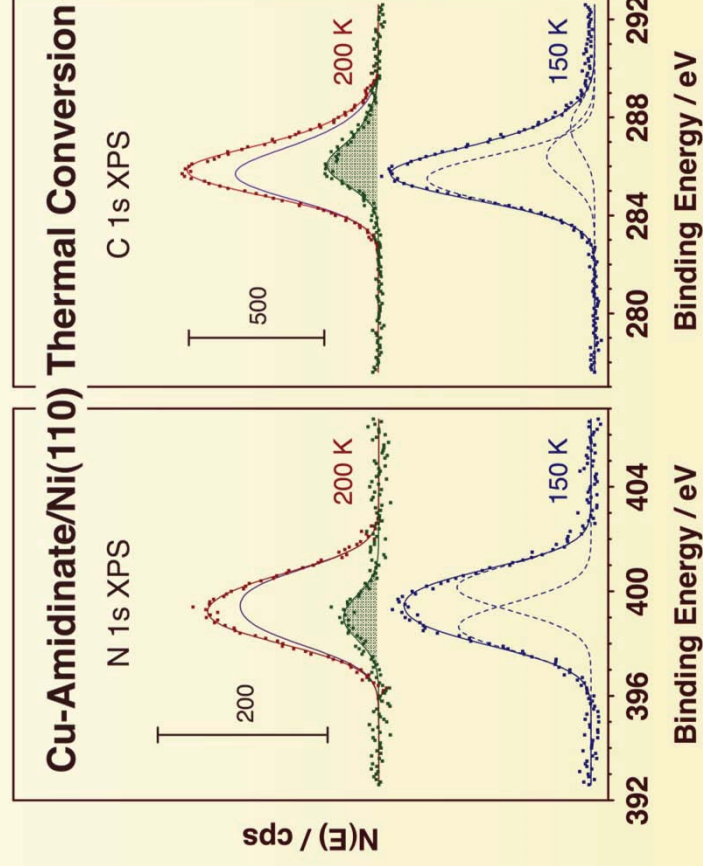
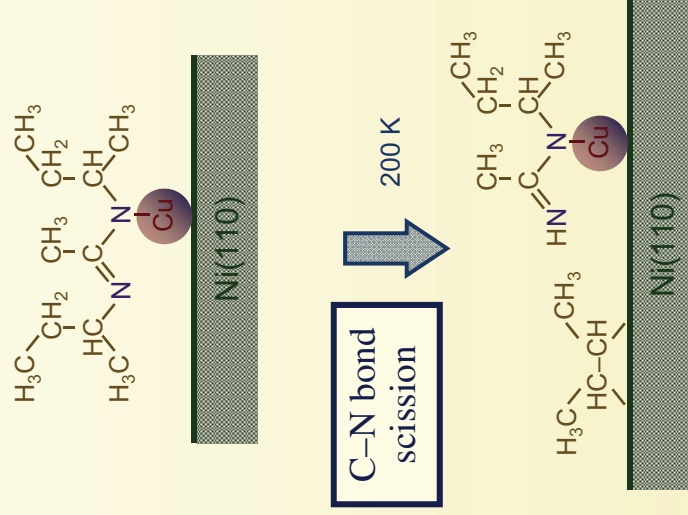
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First C–N Bond Dissociation, $T \sim 200$ K



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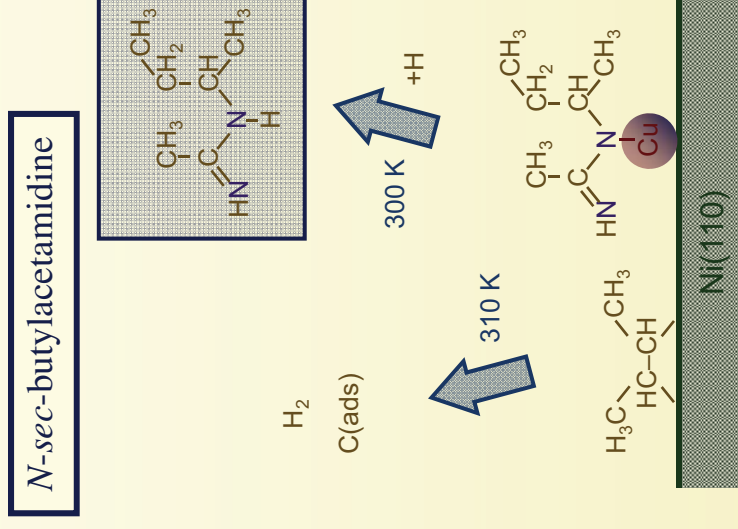
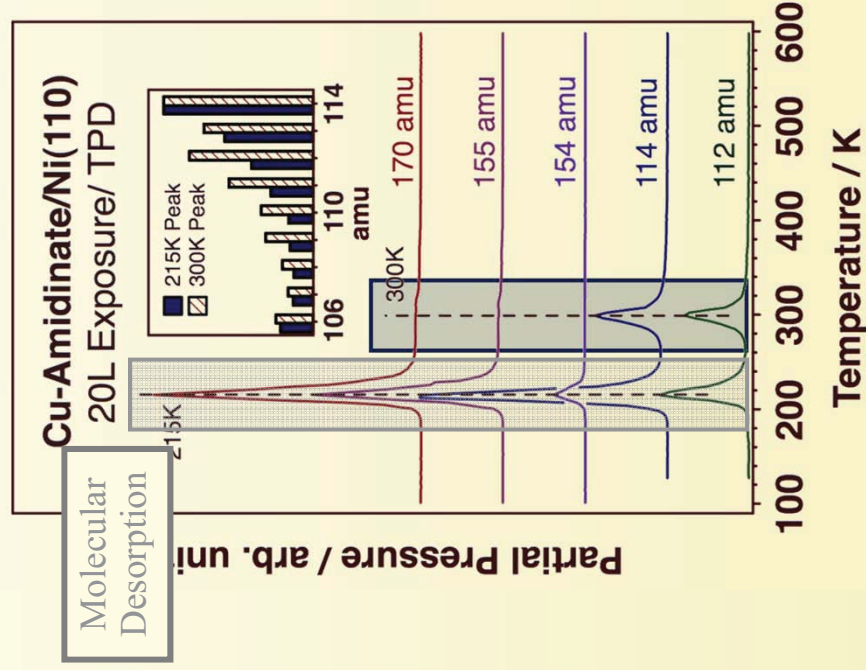
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N-*sec*-Butylacetamidine Formation



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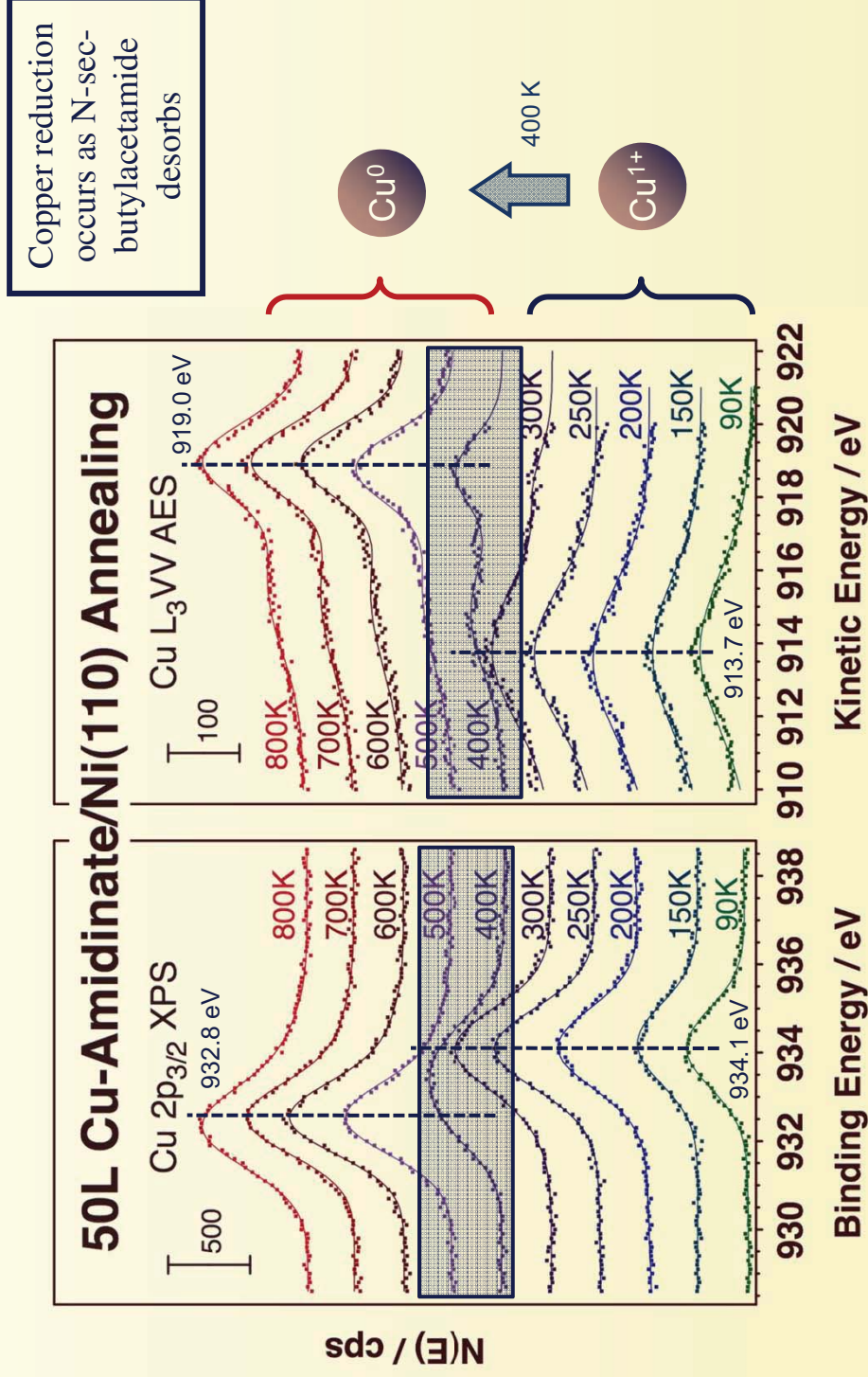
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Cu Reduction



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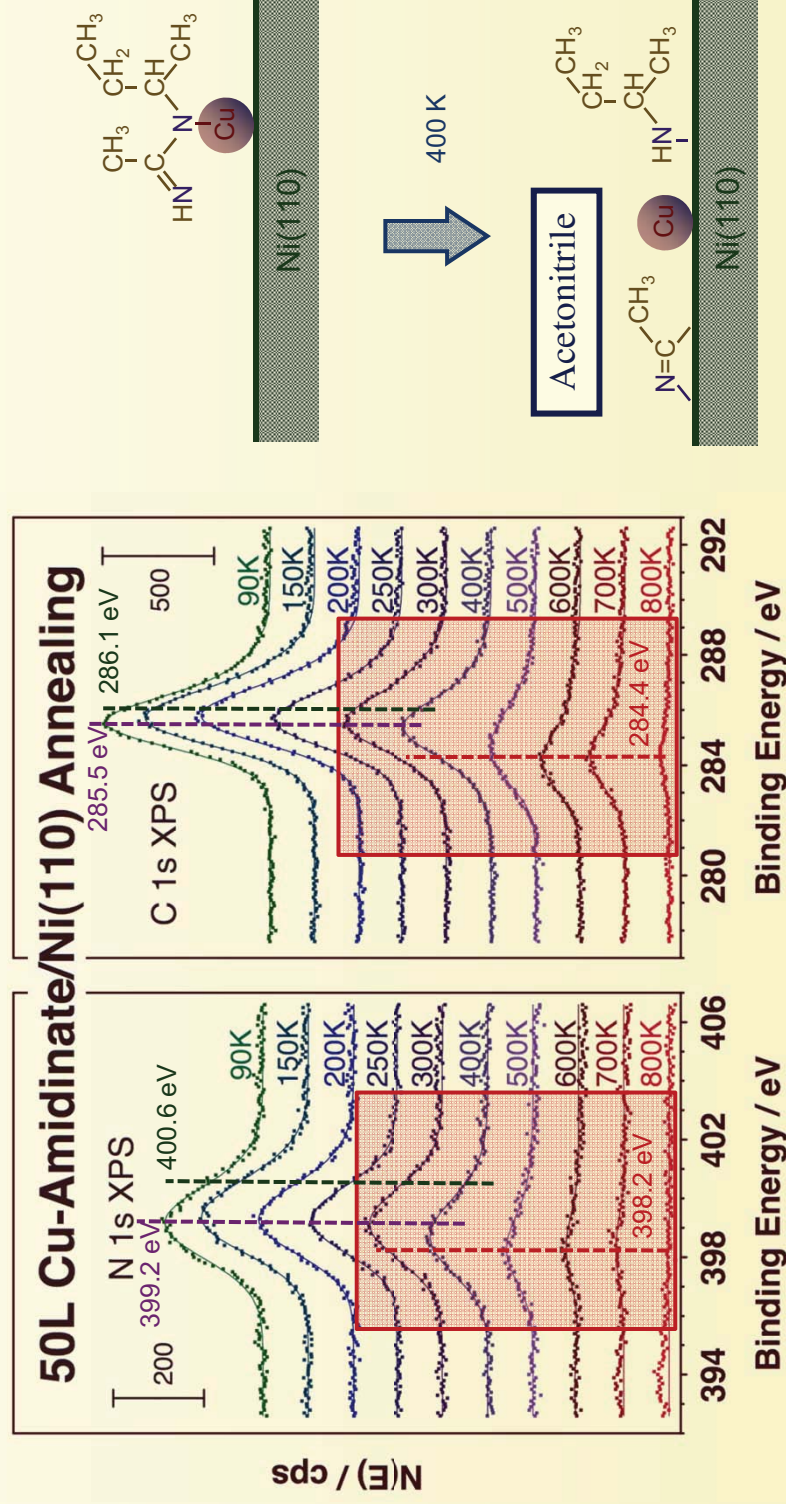
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High Temperature Conversion, C 1s and N 1s XPS



M. Xu, H. Tiznado, B.-C. Kang, M. Bouman, I. Lee, F. Zaera, *J. Kor. Phys. Soc.*, **51**(3), 1063-1068 (2007).
Q. Ma, H. Guo, R. G. Gordon, F. Zaera, *Chem. Mater.* (2011).

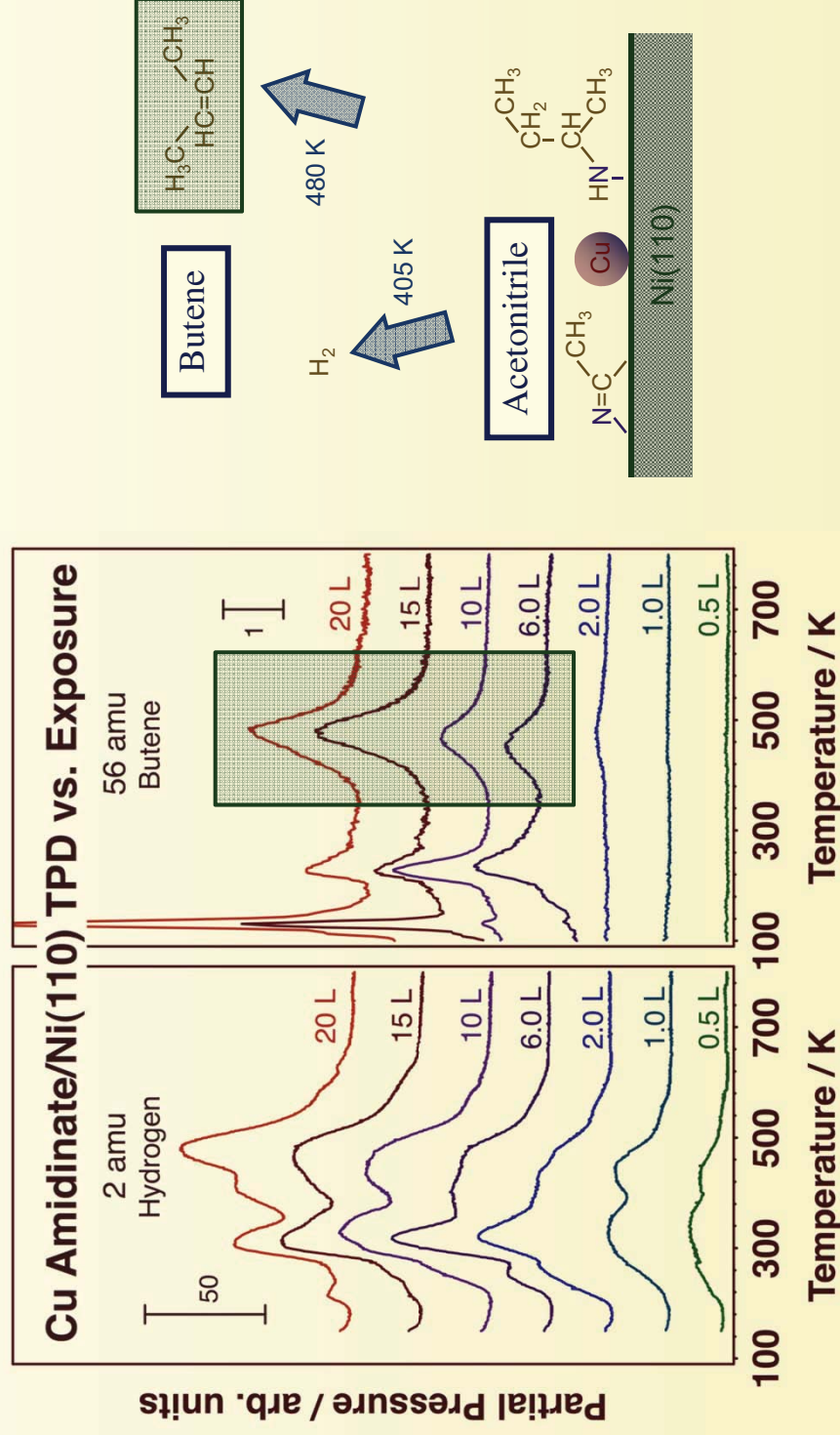


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Cu Amidinate Thermal Chemistry

Butene Formation and Further Dehydrogenation



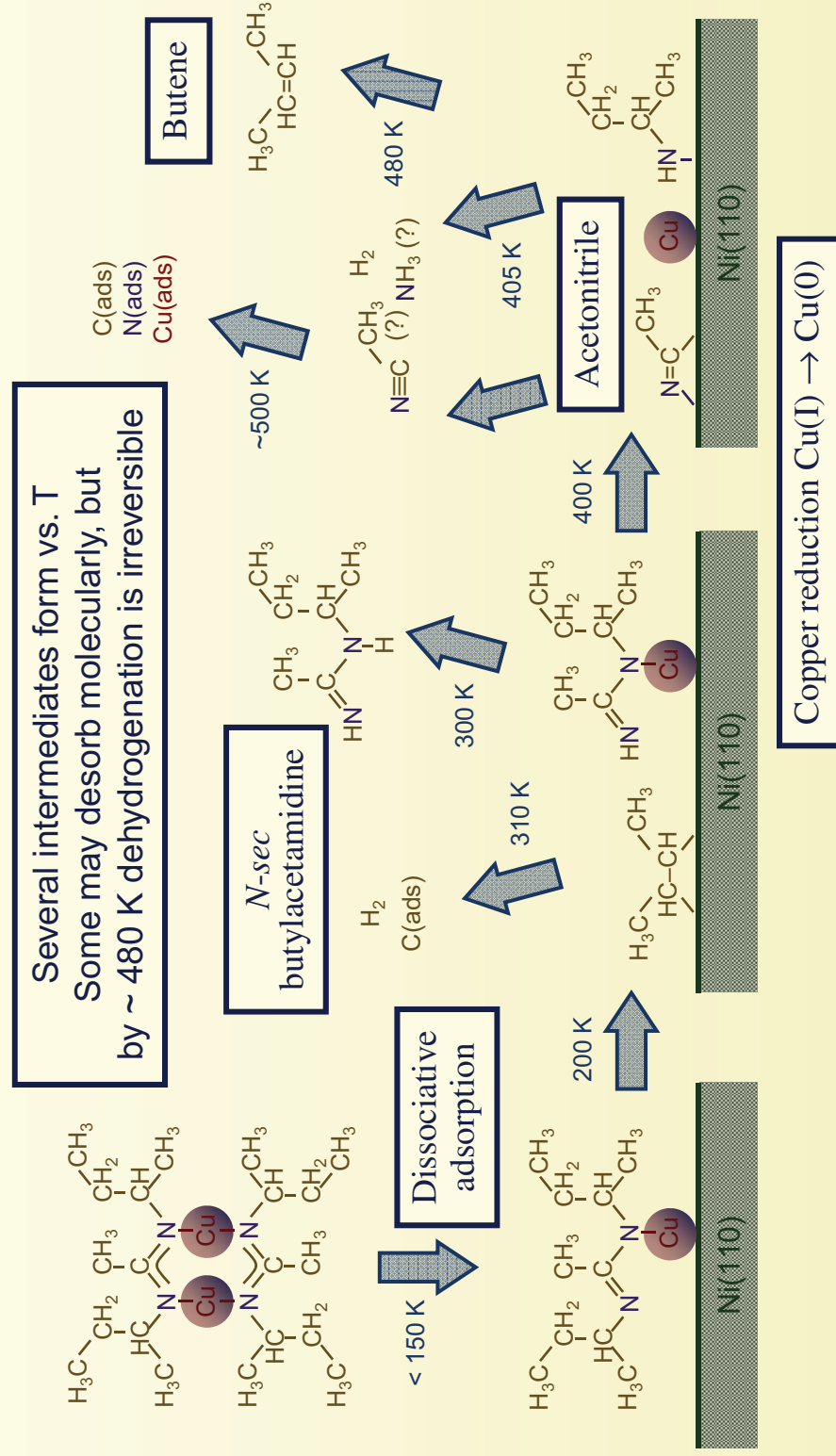
Q. Ma, H. Guo, R. G. Gordon, F. Zaera, *Chem. Mater.* (2011).

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Proposed Mechanism



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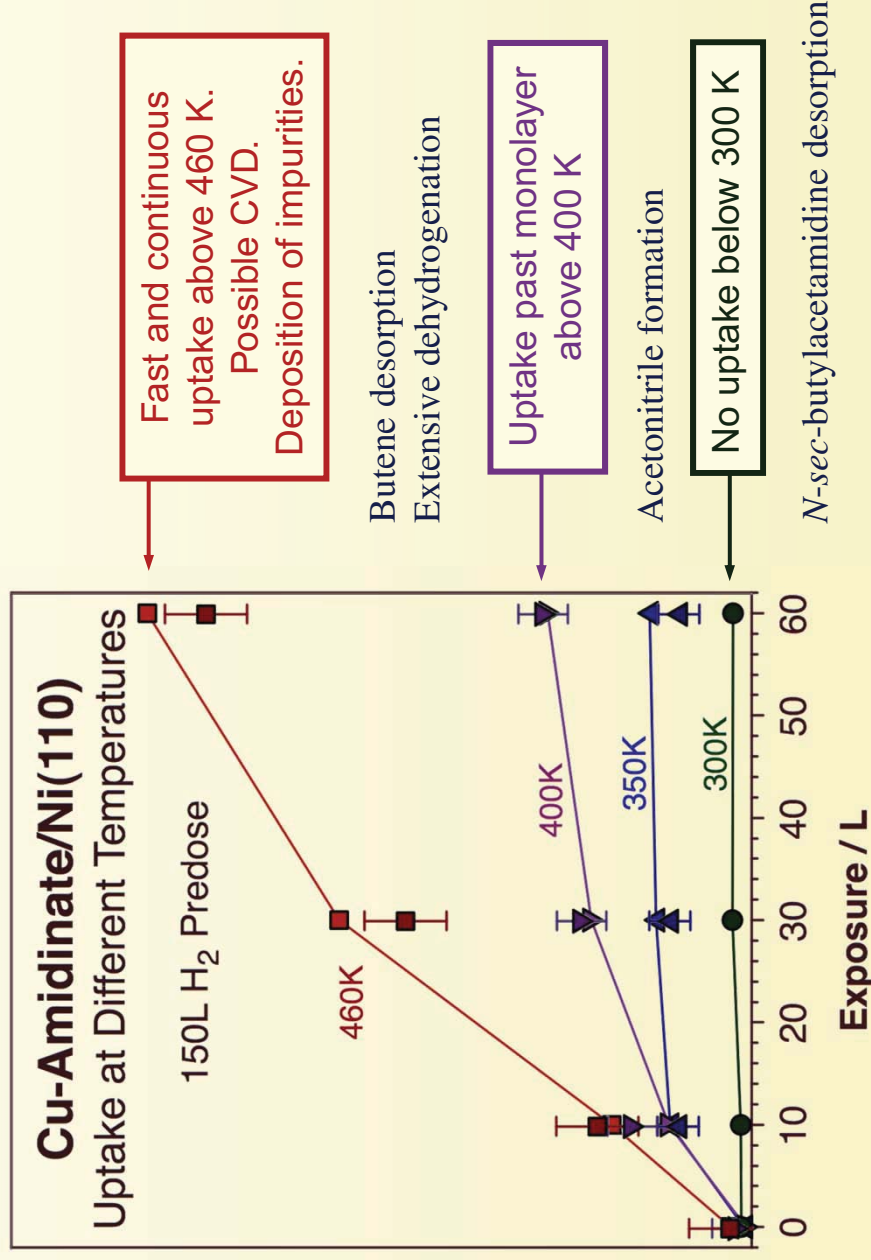
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Cu Amidinate Uptake

Effect of Temperature and Hydrogen



No appreciable changes seen with hydrogen surface presaturation

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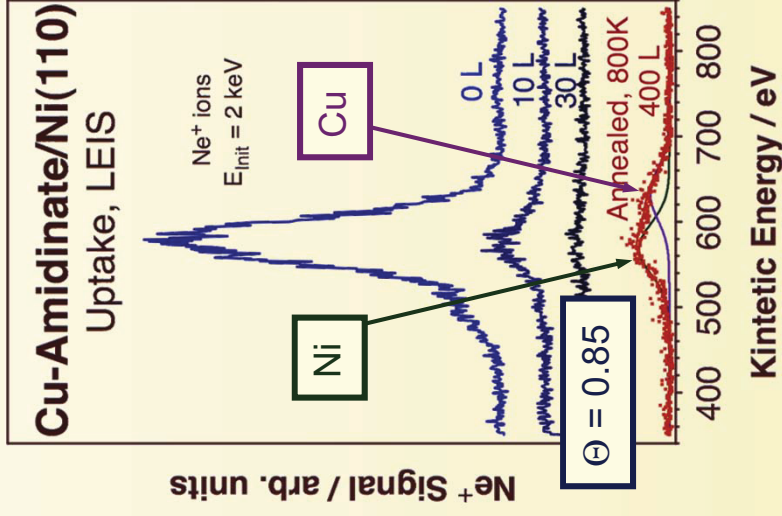
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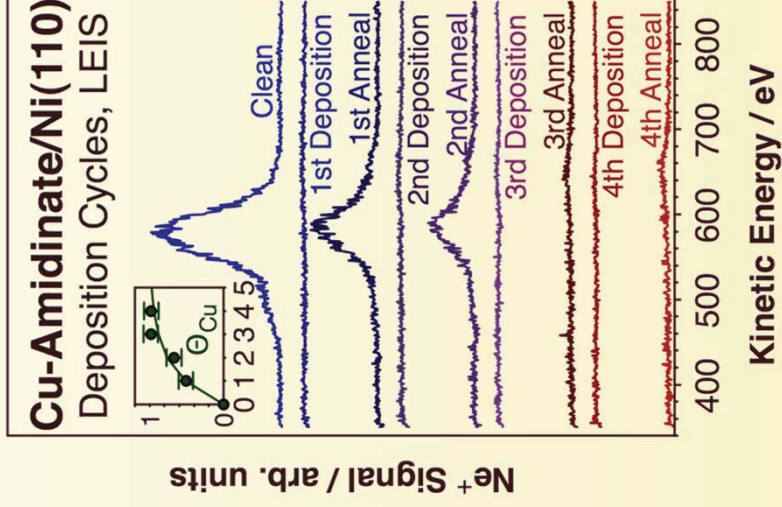


Cu Amidinate Uptake

Growth Rate, LEIS



Saturation at ~ 15 L
Some surface uncovered upon annealing



~ 3 Cycles/Cu ML
in ALD mode

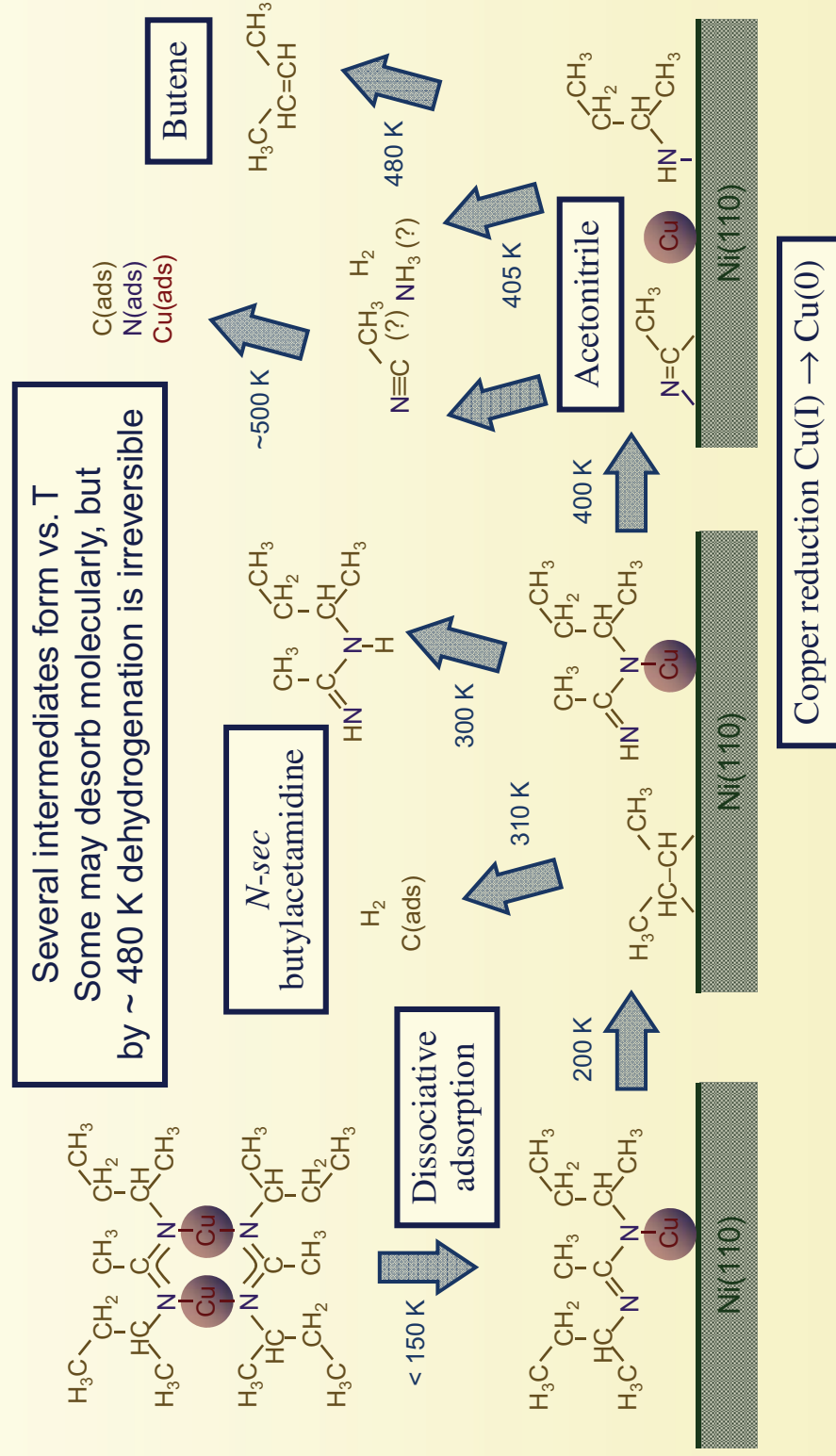
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