Sunday Morning, July 16, 2017

Plenary Session
Room Plaza ABC - Session PS2-SuM

Sunday Plenary Session II

Moderators: Steven M. George, University of Colorado at Boulder, Keren J. Kanarik, Lam Research Corp.

10:45am **PS2-SuM-12 Atomic Layer Etching – An Overview of Possibilities and Limitations*, Richard Gottscho,*** Lam Research Corp. **INVITED**

Exceeding expectations set back in the 1980s, today the field of plasma etching is more critical than ever to formation of nanometer-sized features in a $35-40 billion chip equipment industry. For most critical etch applications such as pattern-transfer and 3D structure formation, an essential requirement is the anisotropic removal of material. Plasma is important because it provides the energetic, directional ions that enable anisotropy, while also producing radicals to accelerate reactions. Conventional plasma etching was for many years considered a “black box” of coupled non-linear interactions between ions and radicals [1]. Atomic layer etching (ALE) is an advanced etch technique used in the fabrication of 10 nm logic. By virtue of its separated and self-limiting steps, ALE offers a simplified system in which to understand etch mechanisms. In this talk, we’ll explore plasma ALE focusing on silicon ALE as a case study before expanding the concepts and applying them to a variety of other materials relevant to the industry such as Ge, C, W, GaN, and SiO_2 [2, 3]. A “synergy” parameter quantifies the degree to which each process approaches the ideal ALE regime and is related to the energetics of underlying surface interactions. By systematically studying a group of materials, we show that synergy scales with surface binding energy of the bulk material. This helps explain why some materials are inherently more (or less) amenable to the ALE approach. The insights will be vital for exploiting ALE in the fabrication of future devices.

[1] H.F. Winters, J.W. Coburn, E. Kay, J. Appl. Phys. 48, 4973 (1977)

[2] K.J. Kanarik et al., J. Vac. Sci. Technol. A 33(2), Mar/Apr 2015

[3] K.J.Kanarik et al, J. Vac. Sci. Technol. Submitted Dec 2016

Author Index

Bold page numbers indicate presenter

— G —
Gottscho, R: PS2-SuM-12, **1**