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MATERIALS PROCESSING WITH LOW PRESSURE PLASMA: PRESENT ISSUES AND POSSIBLE SOLUTIONS

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Abstract. Among various materials processing, we focus on thin film fabrication for integrated circuits using low pressure plasma. Present issues of thin film fabrication in semiconductor industry include film deposition at lower temperatures, film stress management, and coverage improvement in trenches. Because of maturities in materials processing using low pressure plasma, there is little room to meet the demands by optimizing processing conditions using conventional plasma reactors. Most conventional thin film fabrication for integrated circuits predominantly employs surface reactions. The elementary surface chemical reactions inherently are described by the Arrhenius equation, and hence lowering the surface temperature easily reduces surface reaction rates by a few orders of magnitude, leading to undesirable changes of compositions, structures, and properties of films. One possible approach to overcome this surface reaction limited bottleneck is to employ gas phase reactions in a sophisticated way. By using this approach, we have realized 1) SiNx films at 100 ºC, whose qualities are comparable to SiNx films at 350 ºC deposited by conventional plasma CVD, 2) stress reduction of DLC films, and 3) coverage improvement of SiOx films in trenches. The results suggest that possible solutions should combined with development of new concept reactors in order to satisfy the aggressive demands in industry. Such challenges will open new era of semiconductor fabrication.

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