Chemical Vapor Deposition Epitaxy of Silicon-based Materials using Neopentasilane

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For the past several years we have investigated the use of neopentasilane (Si_5H_{12}) as a precursor for the chemical vapor deposition epitaxy of silicon, $Si_{1-x}Ge_x$, and $Si_{1-y}C_y$ alloys at temperatures from 550 to 700 ^oC. High growth rates (over 100 nm/min for silicon at 600 ^oC) and high layer quality by TEM and MOSFET mobility have been observed. This talk will summarize these experimental results, and then discuss open questions, especially regarding the growth mechanism. For example, for nearly all silicon-based CVD with more standard precursors, the growth rate at low temperatures is usually limited by hydrogen desorption from the surface. This hypothesis is supported by the fact that when the partial pressure of the hydrogen carrier is reduced during the growth of silicon (reducing the equilibrium surface coverage of hydrogen), the growth rates rapidly increase [1]. However, when neopentasilane is used as a precursor, virtually no change in growth rate is observed when nitrogen is substituted for a hydrogen carrier. We will propose models to explain both this effect and the high growth rates.

1. W.A.P. Claassen, Philips J. Res **36**, pp. 122-137 (1981).