Cambridge NanoTech Inc.

A Harvard Spin-Off Success Story

In 2003, Dr. Jill Becker and Dr. Douwe Monsma founded Cambridge NanoTech Inc. to manufacture atomic layer deposition (ALD) systems for research, development and industrial applications. From 1998 to 2003, Jill was a Ph.D. student in Professor Roy Gordon's lab in the Department of Chemistry and Chemical Biology (CCB) and Douwe was a post-doctoral fellow with the Marcus Group in the Department of Physics from 2001 to 2003.

While looking for better gate dielectrics for nanoelectronic devices, Douwe visited the Gordon Group to discuss Atomic Layer Deposition (ALD). It was then that Jill and Douwe began a fruitful collaboration resulting in many scientific papers. As a project of the Materials Research Science and Engineering Center (MRSEC), they built their own ALD system for use in their research as no commercial systems were available at that time. Their collaboration made great use of CNS facilities, both to pattern films and devices (e-beam lithography, photolithography), as well as analyze them (SIMS, SEM, TEM etc.). Members of the Marcus Group were astonished by the quality of the film produced by ALD compared to other techniques they had tried.

After Douwe finished his postdoc and Jill completed her Ph.D., they decided to partner up again to form Cambridge NanoTech Inc., a company with the aim of manufacturing affordable ALD systems for researchers worldwide. Now in 2007, Cambridge NanoTech is the market leader and has sold more than 55 ALD systems, and has expanded partially through the hiring of students. These entrepreneurs have not forgotten their Harvard roots and are corporate users of CNS facilities in order to continue to optimize their materials and systems.

Atomic Layer Deposition (ALD) is a coating technology that allows perfectly conformal deposition onto complex 3D surfaces. The reason for this uniform coating lies in the saturative chemisorption of sequential cycles of precursor vapors. To illustrate this, refer to Fig. 1. In Fig. 1a a silicon surface is terminated with hydroxyl groups (formed during contact with air). The wafer is inserted in an ALD reactor, and a first precursor is introduced (here trimethyl aluminum, TMA, Fig 1a-b) using a fast pulse valve to a cylinder with liquid TMA. The precursor reacts with the surface layer, but not with itself, forming a single saturated monolayer. Subsequently, the TMA vapor and methane reaction products are pumped away and water vapor is introduced (Fig. 1c-d). This forms a saturated monolayer of oxygen (Fig. 1e), with a volatile reaction product of methane (again a saturated monolayer because the water molecules don't react anymore after the water formed the hydroxyl (OH) passivated surface). The methane and water are pumped away and the cycle is repeated until the desired coating thickness is obtained (Fig. 1e).

Cambridge NanoTech Inc's typical Savannah 100 Model ALD System

For more information regarding ALD technology and Cambridge NanoTech, please see their website at the URL: http://www.cambridgenanotech.com.

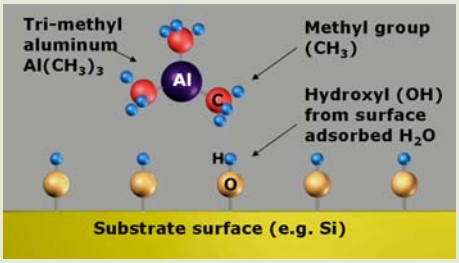

Fig. 1a

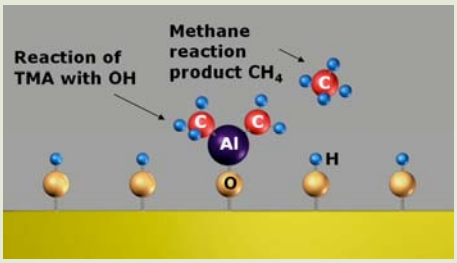

Fig. 1b

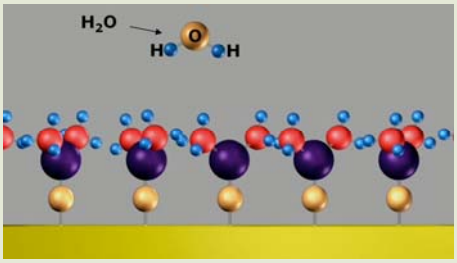

Fig. 1c

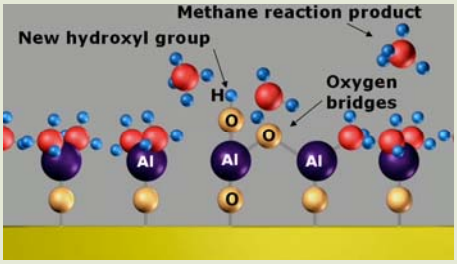

Fig. 1d

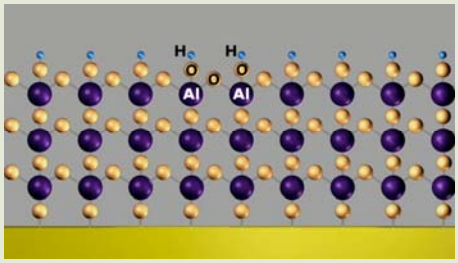

Fig. 1e

Fig. 1a-e. Atomic Layer Deposition reaction cycle showing the formation of Al_2O_3 coating using trimethyl-aluminum and water as precursors, and methane as volatile reaction product.