DESIGNING, MODELING, MANUFACTURING, AND TESTING AN ATOMIC LAYER DEPOSITION SYSTEM

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ABSTRACT

A well-designed reactor for ALD process needs to have the ability to operate under high vacuum, high temperatures, and intense reactions. In the designed reactor within this project, a showerhead, a stage heater, a ceramic spacer, and stage holder were designed and manufactured. To have a good control on the flow rate of precursors, individual mass flow controllers and four ALD Solenoid Valves, are used to regulate the flow of each precursor. Bubblers are used to contain precursors at the entry point of the gas delivery line.

There are five parts in the designed system that have separate thermocouples and heaters. Each of bubblers, tubings, the reaction chamber's body, and substrate stage can get to a separate temperature using PID controllers. Finally a box designed for all the PID controllers and relays to read all the temperatures side-by-side. In addition, there is a terminal box that connects all the tubings' heaters and chamber heaters together. To control gas flow and ALD Valves, a software program was developed that can send digital signals to DAQ cards and the cards can change it to analog signal and send to MFCs and Valves. A control box is designed that contains all the four DAQ cards and a circuit that gives us the ability to control the valves by low currents.

Finally the ALD was tested for process of depositing Al_2O_3 on top of silicon substrate. EDS test were performed to prove the deposition of Al_2O_3 also AFM test showed very flat were fabricated. The results of tests ensured the ability of the ALD to deposit films.