Kurt J. Lesker Company

Enabling Technology for a Better World

www.lesker.com

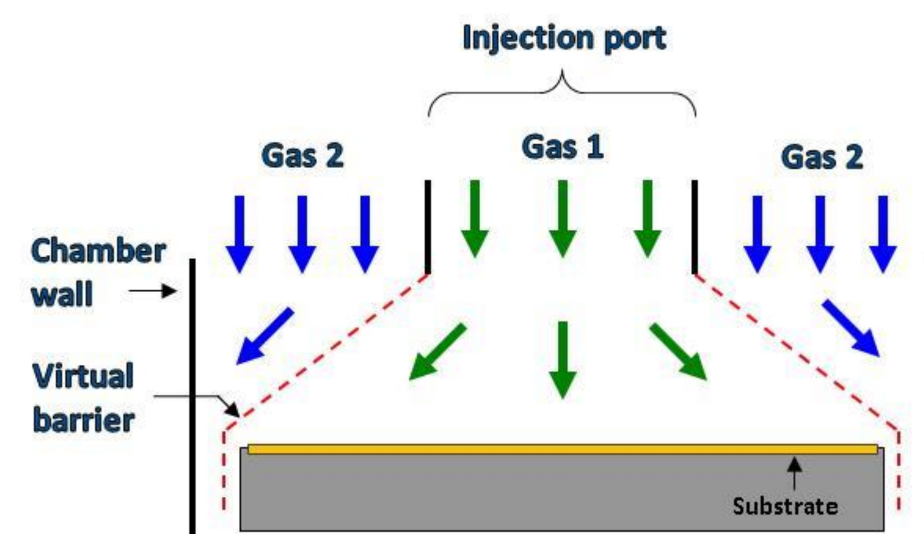
KJLC® Awarded a Patent* for its Atomic Layer Deposition System and Process

Precursor Focusing Technology™ that is enabling Next Generation Research

INTRODUCTION

The ALD-150LX incorporates various reactor design features for advanced, single-wafer R&D including remote plasma, real-time ellipsometry, and cluster tool integration capabilities. These enhanced features present design challenges that must be overcome to optimize performance, and to minimize reactor downtime. In particular, the additional ports necessary to incorporate these features result in a more complex reactor geometry as well as increased internal volume that make precursor delivery, and effective purging between precursor dose steps, more difficult. Film deposition on internal surfaces (especially inside of reactor ports) should be minimized to avoid excessive precursor waste and buildup of material resulting in premature delamination and particulate formation that require maintenance. On some reactor surfaces deposition must be prevented altogether. For example, conductive layers must be avoided on the transparent windows necessary for light transmission during ellipsometry.

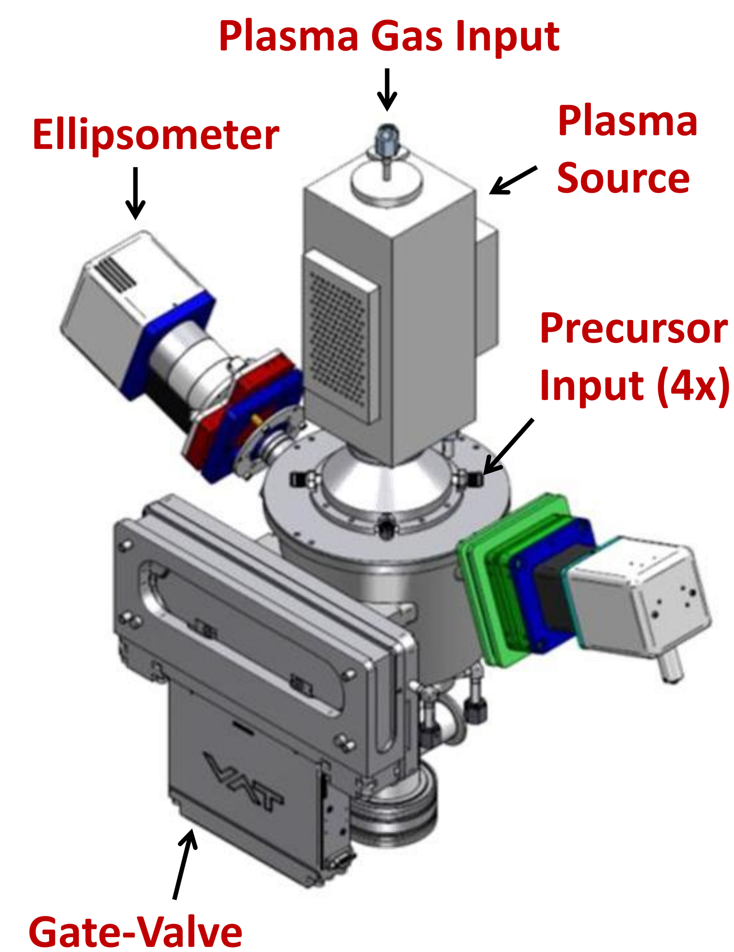
Precursor Focusing Technology™ (PFT™) was developed to address these challenges for optimal system performance with extended intervals between maintenance cycles. The PFT™ design concept is based on viscous-laminar flow perpendicular to substrate surface (perpendicular flow design).



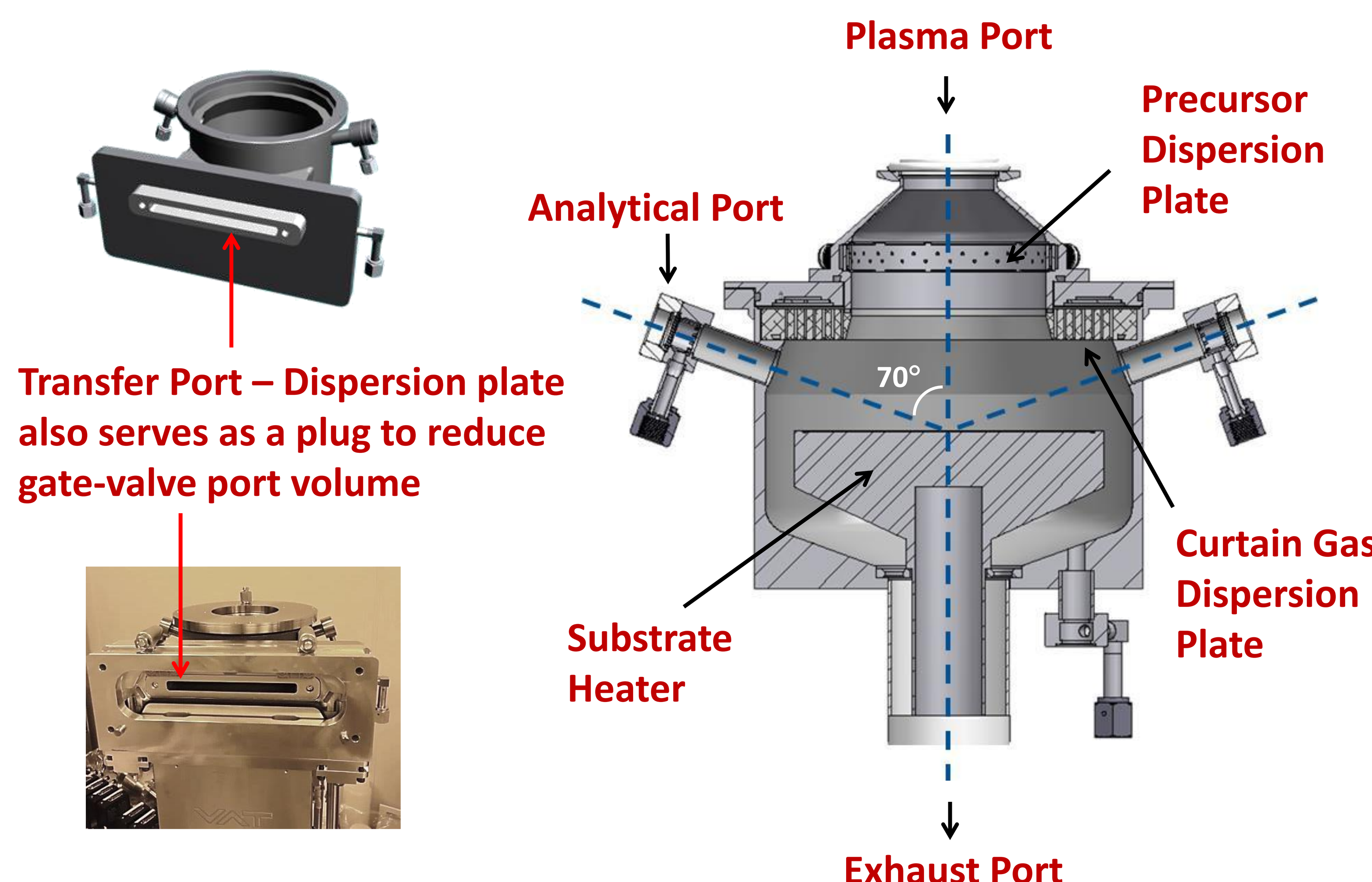
As illustrated in the above figure, Gas 1 is injected through a central injection port positioned directly above the substrate surface. Gas 2 creates virtual barrier that focuses Gas 1 toward substrate surface thereby limiting diffusion toward the chamber walls & ports (additional process chamber ports not shown here for clarity).

***U.S. Patent No. 9,695,510, "Atomic Layer Deposition Apparatus and Process" (2017).**

REACTOR OVERVIEW

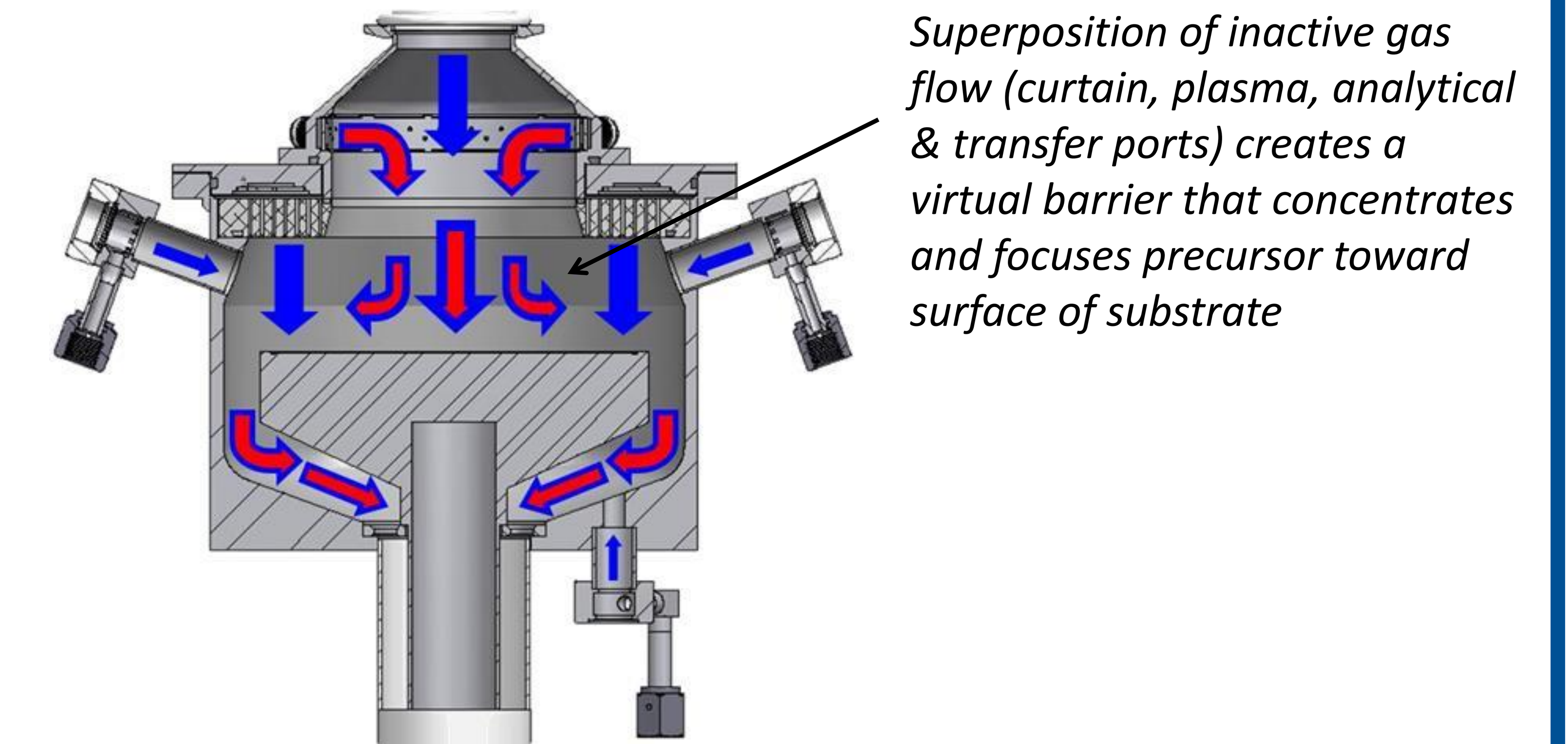


- The remote inductively coupled plasma (ICP) source is vertically mounted to the reactor lid assembly.
- Ellipsometer components are attached to the reactor analytical ports.
- Gate-valve (for reactor isolation) is mounted to the substrate transfer port.
- Five independent precursor inputs are introduced through reactor lid assembly (including plasma).



- Axis of the reactor is perpendicular to the substrate surface. Plasma & exhaust ports are centralized for gas flow uniformity.
- Inactive gas is provided for all reactor ports. In addition, dispersion plates are used for precursor, curtain gas, analytical & transfer ports promote gas flow uniformity & distribution.

PRECURSOR FOCUSING TECHNOLOGY™



Inactive gas flow (Ar, N_2) through the reactor is continuous, viscous and laminar with a well defined flow pattern. In the above figure, the blue-red arrows indicate mixing of inactive gas and precursor during a dose step. The superposition of inactive gas flow (curtain, plasma, analytical & transfer ports) creates a virtual barrier that concentrates & focuses precursor toward the substrate surface. This focusing effect promotes efficient precursor utilization & purging. PFT™ also protects analytical, transfer & plasma ports from precursor exposure as illustrated in the pictures below. These pictures demonstrate the effectiveness of PFT™ by showing limited material build-up inside of analytical, transfer & plasma ports after ~2 years of heavy oxide and nitride ALD/PEALD processing.