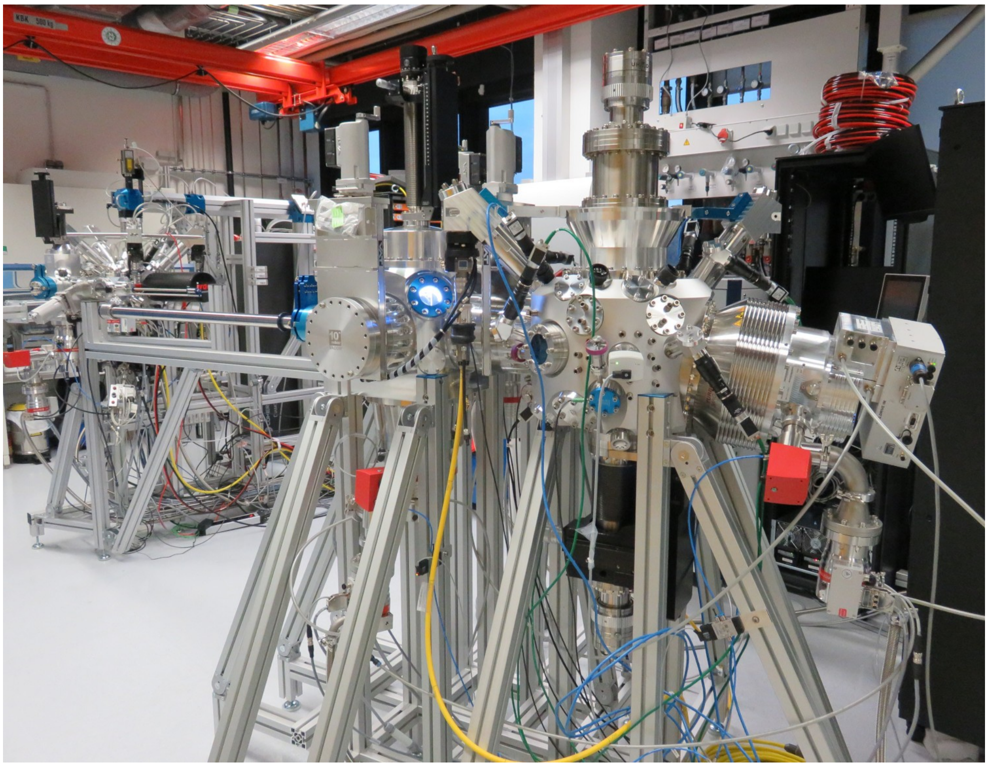
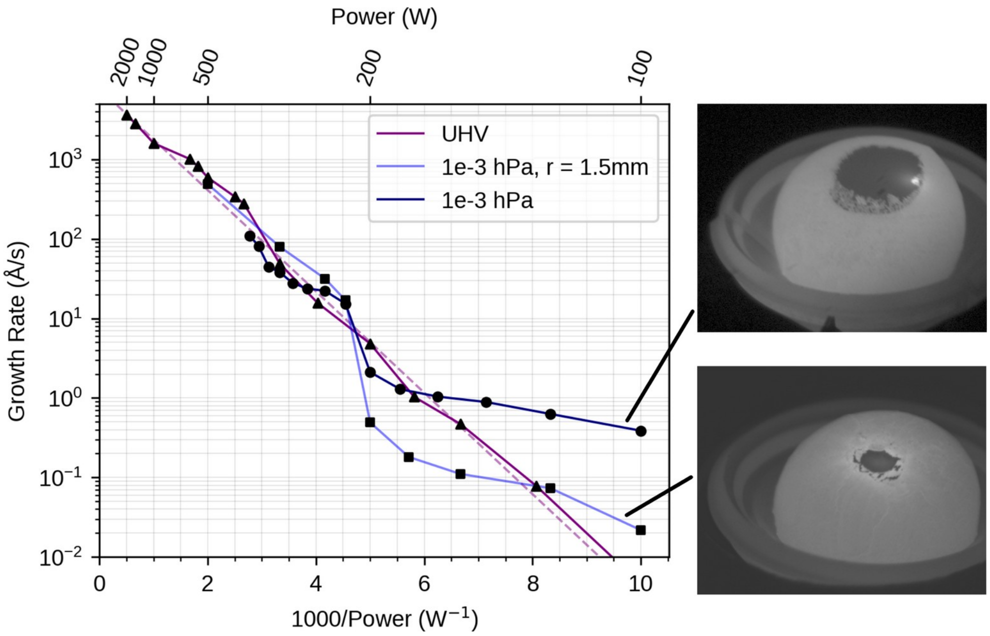


Fig. 1: State of the art triple-chamber TLE research systems. The smaller system in the back is designed for substrate sizes up to 2”, the larger one in the front for substrate sizes up to 4”. The 1 µm wavelength source heating lasers are coupled to the machine via the yellow fiber cables, 10 µm wavelength $CO_2$ beamline-guided lasers are used for substrate heating.

The compact design ensures high pumping speeds and small footprints. The sources are transferred into and out of the growth chamber via a single transfer mechanism also used for sample transfer. They may be stored in the middle chamber for high purity and rapid exchange.

Fig. 2: Growth rates of TLE Al sources (12 mm diameter sapphire crucibles) at three different $O_2$ background pressures as a function of laser power for a fixed spot diameter on the source of about 0.7 mm FWHM. In the presence of $10^{-3}$ hPa $O_2$, the flux deviates from the approximately straight line measured in UHV at low powers, indicating the formation of a volatile suboxide at the source surface depending on the oxygen pressure (not shown) and the metallic area as defined by either a stationary (bottom) or circularly moving beam (top).



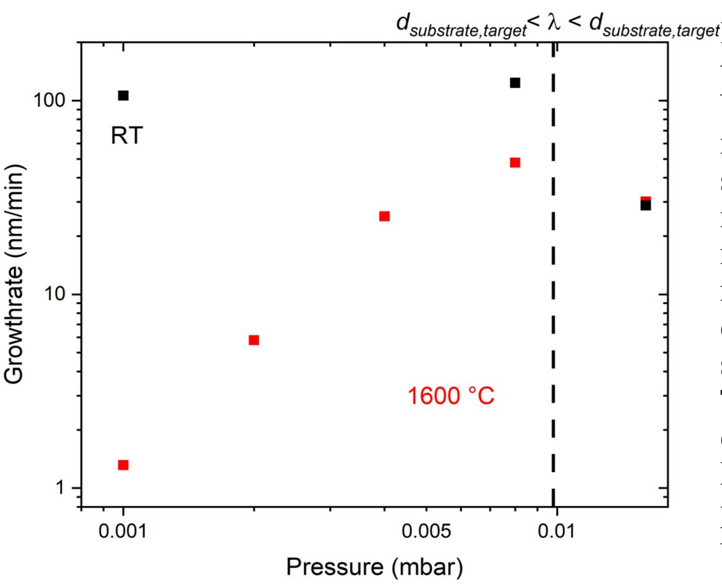




Fig. 3: Transition of $Al_2O_3$ growth from the ballistic to the diffusive transport regime at around $10^{-2}$ hPa $O_2$ background pressure. This transition corresponds to the mean free path of the $O_2$ dropping below the source-sample distance of 80 mm. RT denotes deposition at room temperature, the red points show the deposition rate in the adsorption-limited homoepitaxial growth regime at a substrate temperature of 1600 °C. For details on the adsorption-limited epitaxy, refer to the submission by Felix Hensling.

The very high dynamic range of TLE sources, spanning over 5 orders of magnitude in flux for a factor of 20 in laser power (see Fig. 2), combined with very rapid power modulation allows high growth rate deposition at ultrahigh quality with economic use of source material.