

Design and construction of an ultra-high vacuum set up for the characterization of getter films deposited on wafers

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Single film or multilayers of pure transition metals or alloys are widely used as getter films to reduce the background pressure in ultra-high vacuum (UHV) systems like particle accelerators, and in wafer-level vacuum packaging of resonant or thermal microelectromechanical systems (MEMS). The design, construction and automation of an home-made multi-chamber UHV set-up dedicated to the characterization of such getter films was started several years ago in our laboratory. The design aims to comply with requirements that are not filled or only partially by most of getter characterization set-ups reported previously: i) the loading and characterization of external wafers or dies coated with a getter film; ii) in situ outgassing measurements notably of hydrogen and rare gases that are typically not trapped in an irreversible way; iii) in situ characterization of thermal activation of getter films at various temperatures; iv) gas sorption kinetics measurements of a large set of gases at various temperatures and pressures. To reach these specifications, the UHV set-up includes four chambers (Fig.1): a lock-in chamber for 100 mm in diameter wafers, a getter film thermal activation chamber by radiative heating, an analysis chamber, and a storage chamber. The activation and analysis chambers allow internal volume calibration by the pressure rise method or gas sorption measurements (Fig.2). The activation chamber is equipped with a mass spectrometer for gas analysis and with window ports for in situ measurements by optical techniques. The analysis chamber also allows gas analysis by mass spectrometry and can be equipped with an Auger Electron Spectrometer for surface analysis. Finally, the activation-analysis transfer arm can be isolated in the storage chamber after its use. A large set of gases (N_2 , $^{16}O_2$, $^{18}O_2$, dry air, H_2 , D_2 , CO , CH_4) can be injected in the activation and/or analysis chambers for gas sorption kinetics measurements by the known conductance method at various temperatures and with constant pressure or flow rate. We added isotopic gases $^{18}O_2$ and D_2 to use them as tracers for diffusion measurements and to separate oxidation and hydrogenation due to air exposure and to gas sorption. Four tunable leaks can be individually adjusted, selected and calibrated in situ to get known conductance values covering several decades in order to allow a large range of sorption rates measurements.

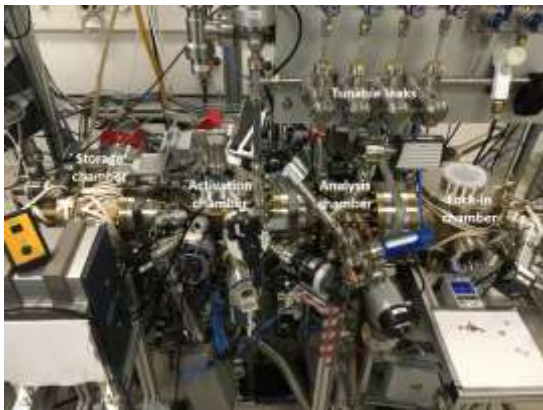


Fig.1. Picture of the ultra-high vacuum set-up for the characterization of getter film activation and sorption.

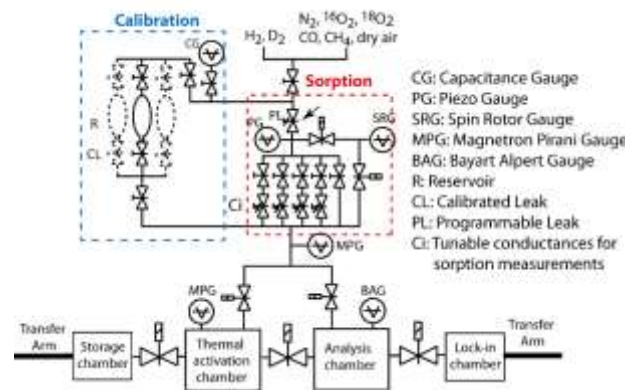


Fig.2. Gas lines layout for Ci conductances calibrations and sorption measurements.