Approach for Objective 1:
Retrofit a 2 meter coating chamber with heaters/thermal shroud to perform coating iterations at a high deposition temperatures (200–300 °C).

Approach for Objective 2:
Upgrades existing Ion Beam Splittering (IBS) chamber with a two-gas flow controller system. Krypton gas is used in situ during IBS deposition. In addition, Freon (C4F8) is used as reactive gas to enhance the (MgF2) microcrystallinity. Finally, we added heaters to the chamber to improve microcrystalline film properties.

Approach for Objective 3:
Optimize deposition process of lanthanide trifluorides as high-index materials that when paired with either MgF2 or LiF will enhance reflectance of Al mirrors at Lyman-alpha.

Al+MgF2 Coating Performance:
3-step coating process:
- Al is coated on the substrate at room temperature to the planned layer thickness.
- As soon as possible after the Al deposition, overlay the Al layer and substrates at room temperature with a thin 0.5-mm layer of MgF2, in order to protect the Al from oxidation and contamination.
- Heat the substrate to 280–300 °C and finish the planned MgF2 thickness MgF2.

Results:

1-meter Chamber Results
- Recently started test run in centre of 1-meter chamber to optimize the 3-step-process for depositing Al+MgF2 coatings
- Improved deposition obtained by heating (~250 °C) substrates during MgF2 deposition
- Reflections > 98% even at 1558 nm

2-meter Chamber Results

Micro-roughness Al+MgF2 Films

The tables above show micro-roughness results on two classes of Al+MgF2 coatings done with the MgF2 layer deposited at ambient (left) and at elevated (right) temperatures. The table on the right shows the average roughness for the elevated MgF2 deposition is 30% smaller.

Conclusions

The paper will present recent advances in reflectance performance for Al+MgF2 mirrors optimized for Lyman-alpha wavelength by performing the deposition of the MgF2 overcoat at elevated substrate temperatures. We will also present optical characterization of the most rare-earth fluorides such as GdF3 and LuF3 that exhibit low-absorption over a wide wavelength range and could therefore be used as high refractive index alternatives for dielectric coatings at FUV wavelengths.