Title:

Optimizing an ultra-high vacuum system for growth-to-thin films studies by mass spectrometry

Abstract:

Thin film growth for energy technology applications has been widely performed by Pulsed Laser Deposition (PLD). Nevertheless, the apparent simplicity of PLD hides underlying complex and simultaneously occurring phenomena in the laser-induced plasma. The typical cumbersome trial-and-error preparation of thin films can be eased by a detailed understanding of the plasma chemistry using *in situ* secondary ion mass spectrometry. This approach is highly desirable for a more targeted growth of films with a complex composition.

Films prepared by PLD with a multi-elemental composition typically suffer from the competition between light and heavy elements in the expanding laser-induced plasma plume. Heavy plasma species typically correspond to slow species with high kinetic energies as compare to the fast lighter elements. The resulting differences in expansion velocities and therefore different arrival times at the substrate causes compositional and spatial deviation, both in the plasma plume and in the film. The growth of lithium containing energy materials often faces a severe competition between very light and heavy elements, detrimental to the growths and hence to their physical and chemical properties. The main goal of this research is to perform detailed time, frequency and spatially resolved optical and mass analysis of the PLD processes. Investigating the mechanisms involving the plasma plume formation, expansion, and subsequent film growth with the suitable UHV setup will benefit how to approach energy materials manufacturing.

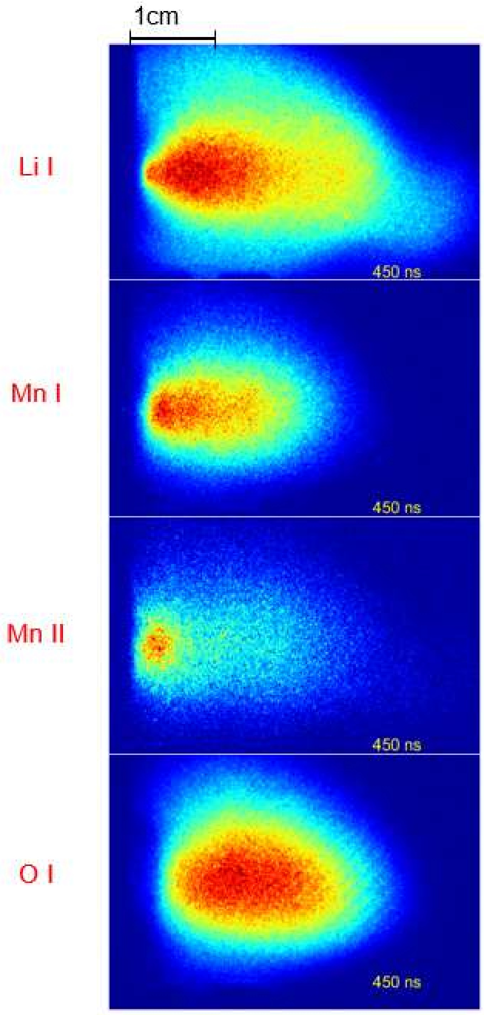

Fig.: Element-selective plasma imaging of the PLD thin film growth of $LiMn_2O_4$

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