In-situ LIBS measurements: characterization of the oxidation and diffusion behavior of technologically relevant materials at operating conditions

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High-performing materials with excellent oxidation resistance at a wide temperature range are needed for applications in the aerospace or machining industry. Before newly developed material systems can be employed, a precise characterization of the mechanical properties and phase stability at operating conditions is crucial to avoid early malfunction. [1] However, estimating the impact of the working conditions on the material properties and their lifespan can be challenging and time-consuming. Considering that aging and subsequent measurements are often separated, additional changes in the sample induced by cooling to room temperature and changes in the atmosphere can't be controlled.
To overcome this potential drawback, an in-house built heating stage, which can be placed inside the ablation chamber of a 266 nm LIBS system, is utilized. This stage allows the aging of samples in temperatures up to 1000°C in various atmospheres (e.g., synthetic air, Ar, He, gas mixtures, etc.) while offering the possibility of making in-situ LIBS analysis. In this way, time-resolved studies of elevated temperatures' impact on technologically relevant materials can be conducted in oxidizing environments, which wouldn’t be possible with classical methods. Moreover, the in-situ LIBS measurements offer the possibility of conducting depth-resolved analysis.

[1] A. Bahr, S. Richter, R. Hahn, T. Wojcik, M. Podsednik, A. Limbeck, J. Ramm, O. Hunold, S. Kolozsvári, H. Riedl, Oxidation behaviour and mechanical properties of sputter-deposited TMSi2 coatings (TM = Mo, Ta, Nb), Journal of Alloys and Compounds, 931 (2022) 167532.