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Cluster tool for in situ processing and characterization of thin films at high temperatures

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In situ processing and comprehensive characterization is essential for design and development of thin films and coatings used in high-temperature applications and processes. Here, a new cluster tool for processing and depth-resolved compositional, structural and optical characterization of layered materials with thicknesses ranging from sub-nm to 1 µm and for temperatures of -100 to 800 °C is described. The implemented techniques comprise magnetron sputtering, ion irradiation, Rutherford backscattering spectrometry, Raman spectroscopy and spectroscopic ellipsometry. The combination of techniques enables sample processing by scalable, clean, waste-free, and industry-relevant technologies, quantitative depth-profiling for elements with $Z \geq 6$, structural and chemical characterization, sensitivity and nm-precise thickness and optical information for single layers, multilayers and mixtures. The performance of the cluster tool is demonstrated for metal-induced crystallization of a model layer stack MgO/ a-Si (~60 nm)/ Ag (~30 nm), and for high-temperature characterization of two solar-selective coating types developed for concentrated solar power applications, namely $Al_yTi_{1-y}(O_xN_{1-x})$-based single and multilayers as well as an n-type doped transparent conductive oxide.
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