In-Situ Measurements of Spectral Emissivities for Verification of $MoSi_2$-Protective Layers on Metal Surfaces at High Temperatures

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Molybdenum disilicide ($MoSi_2$) shows a good oxidation resistance by forming an amorphous SiO_2 passivation film during heating in oxidizing atmosphere which prevents further diffusion of oxygen. This offers the possibility to produce coatings on metals surfaces by thermal spraying molybdenum disilicide as protective layer on construction parts in thermal plants exposed to oxidizing atmospheres at temperatures up to 1600 °C. Aim of the investigation was to find out if in-situ measurements of spectral emissivities could be an effective tool for the evaluation and verification of the layers. At first spectral emissivities of steel and molybdenum substrates without and with $MoSi_2$-coatings were determined in protective atmospheres. Transmission of substrates radiation was not found, the layer showed a characteristic curve of temperature dependent spectral emissivities. The formation of $MoSi_2$-protective layers depends on the heating parameters and does not lead to results which give an optimum oxidation resistance in any case. At about 400°C the so called pest-oxidation can occur which prevents the formation of the layer or leads to damages in existing layers. The investigations showed that differences between layers which are well-formed or influenced by these effects could be detected based on measurement of spectral emissivities. The temperature dependent formation of the layer in oxidizing atmosphere and the influence of pest-oxidation could be shown as strong changes of spectral emissivities at characteristic wavelengths or spectral ranges. In contrast to that, structural changes of the layer at the brittle-ductile transition at about 1000 °C have no influence. The investigations showed that temperature dependent in-situ measurements of spectral emissivities are an effective tool for the evaluation and verification of formation and long-term monitoring of MoSi2-based protective layers on metal surfaces. But it requires a measurement system that works quickly and over wide ranges of temperature and wavelengths.