Dynamic Evolution of the Emissivity of Oxidized Nickel Up to the Formation of an Opaque NiO Layer

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The infrared emissivity is an optical property that is highly dependent on the surface state. Models based on the thin-film approximation have been developed for the study of lightly-oxidized metals. They can be used both to predict emissivity values from experimental data on the oxidation kinetics, and *vice versa*. However, to our knowledge, no systematic investigation of the effect on the emissivity of thick oxide layers with a degree of opacity has been carried out to date. This work presents the first systematic study of the emissivity of an oxidizing metal up to the formation of an opaque oxide layer. The emissivity of Ni has been continuously measured from the unoxidized to the fully oxidized state during an isothermal oxidation at 730 °C. After 33days, the spectra stopped evolving, which meant that the results corresponded to a thick NiO film. The rate of oxidation was determined by thickness measurements using the interference fringes of the emissivity spectra and it was then cross-checked by SEM microscopy. A difference of an order of magnitude was found, which signals an intrinsic limitation of this method for thick oxide layers. The physical foundation of this inconsistency is based on the coherence length of black-body radiation. A discussion of the optical properties of Ni and NiO has also been performed, including the effect of their respective magnetic transitions and the two-phonon structure of the spectra of NiO. The data contained in this work is of great practical importance, since very few studies concern the dependence on the oxidation state on the emissivity in a systematic way.