



The Qualitative Analysis of an n -Dimensional Nonlinear Dynamical System Arising From the Modeling of Multilayer Scales on Pure Metals

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Abstract: A metal oxide is a compound containing oxygen and metal. Certain pure metals can form different oxides, and oxidation of such metals produces a multilayer oxide scale on the metal. In one of their publications, F. Gesmundo and F. Viani qualitatively analyzed the parabolic growth of three-layer oxide scales on those metals which can form three oxides. They obtained a non-linear three-dimensional dynamical system as a model for the growth of such scales. In the present paper we generalize this dynamical system of Gesmundo and Viani to n -dimensions; we then qualitatively analyze this n -dimensional dynamical system.

Keywords: *differential equations; dynamical systems; nonlinear dynamical systems; cooperative dynamical systems.*

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1 Introduction

A metal oxide is a compound containing oxygen and metal. For instance, common rust is caused by the oxidation of metal. Certain pure metals can form different oxides, and oxidation of such metals produces a multilayer oxide scale on the metal, where the oxide layer containing the highest concentration of metal is in contact with the surface of the metal, while the oxide layer containing the highest concentration of oxygen is in contact with the gas or oxygen to which the surface of the metal is exposed. In paper [4], F. Gesmundo and F. Viani analyzed the parabolic growth of three-layer oxide scales on

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