CYPRUS UNIVERSITY OF TECHNOLOGY

FACULTY OF ENGINEERING AND TECHNOLOGY

MASTER THESIS

CONTROLLING THE PROPERTIES OF OXIDE-BASED COMPOSITE FILMS BY USING UNARY AND MULTI-COMPONENT PARTICLE FORMATIONS

Marios Demosthenous

Limassol 2015

CYPRUS UNIVERSITY OF TECHNOLOGY

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL ENGINEERING AND MATERIALS SCIENCE AND ENGINEERING

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APPROVAL FORM

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Abstract

A bulk scale process was implemented for the production of film composites comprising particle formations of unary and/or multi-component metallic oxides dispersed in a suitable polymer matrix.

Specifically, the process made use of silica, alumina, titania and zinc oxides in five types of particle formations: (i) free standing nanoparticles with a size less than 0.1μm and preferably less than 200nm, (ii) free standing particles with a size between 0.1-1μm and preferably in the range 400-700nm, (iii) free standing particles with a size between 1-10μm, (iv) free standing particles with a size greater than 10μm, (v) unary and multi-component granules of nanoparticles with variable but regulated size. Apart from the distinguishing initial characteristics of each particle formation, further physicochemical changes could be instated by thermal treatment, thus resizing their grain and regulating their compositional constituency (stoichiometric or non-stoichiometric).

The processing parameters for fabricating the polymer film composites included: the type of nanoparticle formation, the type of multi-component formulation, the particle size and composition, the degree of particle dispersion in the polymer matrix as dictated by the amount of the active ingredient, the type of plastic resin the magnitude of inter-particle distance and the type of incorporated additives if any.

Suitable experiments were performed to map the optical properties of the as-fabricated films. The optical test results were used to substantiate the capability of the overall methodology while confirming experimentally that the optical properties of the films could be regulated depending on the type of nanoparticle formation which could be adjusted preferentially both in size and composition.