Thin films and multilayers of functional ceramics have a number of important applications including dielectrics, magnetic recording media, piezoelectric transducers, and integrated optical devices. Various functionalyzed self-assembled monolayers, attached to single-crystal silicon substrates, were used to direct the deposition of thin films of the oxides of titanium, zinc, iron, and zirconium, at low temperatures and ambient pressures. The films were uniform, adherent, and pore-free and were, in many cases, comprised of micro-crystalline oxide particles. The monolayer functionality found to be most generally useful for these purposes included hydroxyl, carboxylate, and sulfonate functionality. In some cases the films contained desirable forms of the oxides that were different than those normally obtained: i.e., the anatase form of titania as opposed to rutile; and the tetragonal form of zirconia as opposed to monoclinic version. The patterning of the oxide films by patterning the underlying monolayer was also demonstrated. This project developed new technologies for the production of functional ceramics by creating templates for their deposition from solution and as such is a first step towards the generalized control of microstructural and crystallographic order by interface design in composite organic/inorganic materials.
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AIRCRAFT OF OFFICE OF SCIENTIFIC RESEARCH

Biomimetic Fabrication of Functional Ceramic Composites
Project Period: 6/1/92 - 5/30/96
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Departments of Chemistry and Materials Science Engineering
Case Western Reserve University
Cleveland, OH 44106
Personnel

Principal Investigator          Sukenik, Chaim N. (Prof., Chemistry)
Faculty Co-Investigator         Heuer, Arthur H. (Prof., Materials Science)
Faculty Co-Investigator         DeGuire, Mark R. (Assoc. Prof., Materials Science)
Grad. Stud. Co-Investigator     Maiti, Mou (Materials Science)
Grad. Stud. Co-Investigator     Sitthisuntorn Supothina (Materials Science)
Post Doc. Co-Investigator       Wang, Yoo Hoo (Materials Science)
Undergrad. Co-Investigator      Pfefferkorn, Jeffrey (Chemistry)

Abstract

Thin films and multilayers of functional ceramics have a number of important applications including dielectrics, magnetic recording media, piezoelectric transducers, and integrated optical devices. Various functionalyzed self-assembled monolayers, attached to single-crystal silicon substrates, were used to direct the deposition of thin films of the oxides of titanium, zinc, iron, and zirconium, at low temperatures and ambient pressures. The films were uniform, adherent, and pore-free and were, in many cases, comprised of micro-crystalline oxide particles. The monolayer functionality found to be most generally useful for these purposes included hydroxyl, carboxylate, and sulfonate functionality. In some cases the films contained desirable forms of the oxides that were different than those normally obtained: i.e., the anatase form of titania as opposed to rutile; and the tetragonal form of zirconia as opposed to monoclinic version. The patterning of the oxide films by patterning the underlying monolayer was also demonstrated. This project developed new technologies for the production of functional ceramics by creating templates for their deposition from solution and as such is a first step towards the generalized control of microstructural and crystallographic order by interface design in composite organic/inorganic materials.

Patents


Student theses submitted to CWRU

Published scientific papers in professional journals:


