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Evaluation of Barrier Properties of Organic Coatings By Electrochemical Permeation and Electrochemical Methods

Jessica Venger Nardelli^a, Cecilio Sadao Fugihara^a and Assis Vicente Benedetti^a

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Abstract

This study aims at investigating the transport through free-films of organic coatings derived from vegetable oils (crambe oil and castor oil) plus pre-polymer based on hexamethylene diisocyanate and castor oil, which were used in our previous studies to protect aluminum alloy (AA1200) against corrosion in NaCl solution [1]. The free-films were characterized by Raman, NMR, FTIR and AFM (roughness and texture), and the permeability to KCl in aqueous solutions was investigated by electrochemical impedance spectroscopy (EIS) and open circuit potential (E_{OCP}) measurements as function of time. Different coating formulations were tested to demonstrate the influence of their structure and chemical composition on electrolyte permeability. The good corrosion resistance of these coatings encouraged us to investigate the KCl permeability to assist in understanding the mechanism of corrosion protection of the aluminum alloy surface. The measurements were done by using a setup similar to that employed by Armstrong et al. [2] in 0.1 mol L⁻¹ KCl aqueous solution, at 25 °C and atmospheric pressure. Raman, NMR, and FTIR spectra, and AFM images were taken before and after four months of immersion in the electrolyte and no significant differences between spectra or images were found. These results allowed concluding that no compositional and / or chemical structural and topological changes have occurred in the free-films. EIS and E_{OCP} measurements were conducted with the free-film of organic coatings immersed in 0.1 mol L⁻¹ KCl aqueous solutions for four months at 25 °C and atmospheric pressure. The modulus of impedance remained between 1.2 to 1.7 GΩ cm² suggesting that the coating is not degraded by the solution and K⁺ and Cl⁻ ions permeability is practically insignificant.

References

[1] J.V. Nardelli, D.V. Shirova, C.S. Fugihara, M.F. Montemor, E.R.P. Pinto, Y. Messaddeq, A.V. Benedetti, Localised corrosion assessment of crambe-oil-based polyurethane coatings applied on the ASTM 1200 aluminum alloy, *Corros. Sci.* 111 (2016) 422–435.

Acknowledgments

Process FAPESP: 2015/10554-9.

Footnotes

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Organic Coatings Zeno W. Wicks, Jr., Frank N. Jones, Socrates Peter Pappas, Douglas A. Wicks, 2007-03-15

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Table of Contents Organic Coatings Properties And Evaluation

1. Understanding the eBook Organic Coatings Properties And Evaluation
 - The Rise of Digital Reading Organic Coatings Properties And Evaluation
 - Advantages of eBooks Over Traditional Books
2. Identifying Organic Coatings Properties And Evaluation
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Organic Coatings Properties And Evaluation
 - User-Friendly Interface
4. Exploring eBook Recommendations from Organic Coatings Properties And Evaluation
 - Personalized Recommendations
 - Organic Coatings Properties And Evaluation User Reviews and Ratings
 - Organic Coatings Properties And Evaluation and Bestseller Lists
5. Accessing Organic Coatings Properties And Evaluation Free and Paid eBooks
 - Organic Coatings Properties And Evaluation Public Domain eBooks
 - Organic Coatings Properties And Evaluation eBook Subscription Services
 - Organic Coatings Properties And Evaluation Budget-Friendly Options

6. Navigating Organic Coatings Properties And Evaluation eBook Formats
 - ePub, PDF, MOBI, and More
 - Organic Coatings Properties And Evaluation Compatibility with Devices
 - Organic Coatings Properties And Evaluation Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Organic Coatings Properties And Evaluation
 - Highlighting and Note-Taking Organic Coatings Properties And Evaluation
 - Interactive Elements Organic Coatings Properties And Evaluation
8. Staying Engaged with Organic Coatings Properties And Evaluation
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Organic Coatings Properties And Evaluation
9. Balancing eBooks and Physical Books Organic Coatings Properties And Evaluation
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Organic Coatings Properties And Evaluation
10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
11. Cultivating a Reading Routine Organic Coatings Properties And Evaluation
 - Setting Reading Goals Organic Coatings Properties And Evaluation
 - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Organic Coatings Properties And Evaluation
 - Fact-Checking eBook Content of Organic Coatings Properties And Evaluation
 - Distinguishing Credible Sources
13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
14. Embracing eBook Trends
 - Integration of Multimedia Elements

- Interactive and Gamified eBooks

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