PÔSTER - RESUMO - DISPOSITIVOS OPTOELETRÔNICOS

SURFACE THERMODYNAMICS AND WETTABILITY OF ANODIZED AL2O3 FILMS USING GRAPHICAL USER INTERFACE VOLTAGE CONTROL

João Guilherme Vaz Duarte (joaoguilhermeufpi@gmail.com)

Mayra Carolyne Oliveira De Souza (mayracarolyne@ufpi.edu.br)

Angel Alberto Hidalgo (angel@ufpi.edu.br)

Maria Leticia Vega (marialeticia.vega@ufpi.edu.br)

Anodized aluminum oxide (Al2O3) films have attracted considerable attention due to their high chemical stability, excellent dielectric properties, and versatility for surface functionalization [1]. Beyond their traditional use in protective coatings, anodized oxides have emerged as promising platforms for interfacial engineering in sensing, catalysis, and organic electronic applications. In this context, understanding and controlling surface wettability is essential, as it directly influences adhesion, charge transport, and interfacial stability. In this work, we investigate the influence of electrochemical anodization parameters on the surface thermodynamics and wettability of Al2O3 films through a combination of experimental and thermodynamic analyses. The fabrication methodology relied on controlled oxide growth using a programmable anodization system operated via a graphical user interface developed within the research group. This software-driven approach enabled precise control of key anodization parameters, including applied voltage, anodization time, and voltage ramp profiles. Such programmability ensured high reproducibility and allowed systematic modulation of oxide formation conditions. In addition, the

use of an automated interface minimized operator-dependent variability, providing a robust platform for investigating the relationship between electrochemical parameters and interfacial properties. The resulting films were characterized by static contact angle measurements, enabling quantitative evaluation of wettability and surface heterogeneity[2]. Surface wetting behavior was analyzed within established thermodynamic frameworks, including the Cassie–Baxter model, to account for the influence of apparent roughness and interfacial heterogeneity. Surface free energy values were estimated using multi-liquid approaches, allowing decomposition into polar and dispersive components. Furthermore, variations in Gibbs free energy associated with wetting transitions were calculated to assess the thermodynamic favorability of hydrophilic and hydrophobic regimes. [3]. By correlating anodization parameters with contact angle and thermodynamic descriptors, we identified systematic trends governing the formation of distinct anodized surface topographies and their corresponding wetting states. In particular, voltage modulation and ramp control were found to significantly influence interfacial energy landscapes, enabling transitions between hydrophilic and moderately hydrophobic regimes. These findings highlight the critical role of programmable anodization in tailoring oxide surface energetics without the need for additional chemical functionalization. Overall, this work demonstrates that software-controlled anodization provides an effective route for engineering the surface thermodynamics of anodized Al2O3 films. The integration of programmable electrochemical control with thermodynamic analysis offers a versatile framework for rational wettability design and interfacial optimization. The proposed methodology contributes to the development of accessible, automated, and reproducible strategies for surface characterization and tuning, with potential applications in organic electronics, functional coatings, and advanced oxide-based devices.

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Palavras-chave: anodized al2o3 films; graphical user interface voltage control; wettability.