

Dielectric Properties of TiO₂ Thin Films Prepared by Anodic Oxidation of Titanium

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We investigated the dielectric properties of anodized TiO₂ film for high density capacitor application. Due to the high dielectric permittivity and breakdown strength (BDS), theoretical energy density for the capacitors with TiO₂ thin film reaches several hundreds of watt-hour per kilogram. Preparation methods of TiO₂ film for capacitor application such as atomic layer deposition, physical vapor deposition, sol-gel casting require complex processes and prohibitive costs, whereas the anodic oxidation of high-purity titanium is economically viable and simple method to obtain high dielectric permittivity and BDS with low leakage. In this study, titanium specimens were treated by chemical cleaning and mechanical polishing then anodized under 1 to 100 V electrical potential. Film thickness and refractive index were measured by spectroscopic ellipsometry, and the film morphology was studied by scanning electron microscopy. Anodized TiO₂ films were fabricated into Metal-insulator-metal capacitors for dielectric characterization. Anodizing parameters such as anodizing voltage, current density, electrolyte composition, and surface preparation methods were manipulated for maximizing BDS and minimizing leakage current.