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Real Charge Trapping in Hydroxyapatite Thin Films Prepared by Pulsed Laser Deposition

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Direct injection of electrons into synthetic bone mineral hydroxyapatite can change its surface potential in thin films prepared by spin coating, reduce bacterial adhesion at the surface of bulk ceramics and impact biological adhesion. To explore this further, we investigate direct electron injection, and trapping of charge in hydroxyapatite thin films produced by Pulsed Laser Deposition (PLD) on sapphire (Al2O3) substrates. The films are characterized by X-Ray Diffraction (XRD) for phase composition and X-ray Photoelectron Spectroscopy (XPS) for surface chemistry. Injection of electrons into prepared samples is conducted using an electron beam within a Scanning Electron Microscope (SEM) capable of electron beam lithography with control over dosage, current, and irradiation area. Monte Carlo simulation estimates the beam/sample interaction volume to be ten times larger than the thickness of the hydroxyapatite thin film. This means that incident electrons should largely transmit through hydroxyapatite thin film, and end up in being trapped in the Al2O3 substrate instead of the hydroxyapatite film. Bulk hydroxyapatite, however, can store excess electric charge of the order of 10-9 C, mainly in oxygen vacancies or other defect centres located within the band gap. Thus, in this study, we quantify the charge trapped in hydroxyapatite thin films using a Pendant Drop in Electric Field Method, compare it with charge trapped in bulk samples, and assess the influence of the Al2O3 substrate on charge storage.

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