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Calculating the IV curve and power for a thin-film solar module

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The aim of this thesis was to calculate the IV curve and power for a thin-film solar module. The purpose was to use the developed model for solar array dimensioning and reliable energy prediction. Several different methods were considered. The diode equation proved to work poorly for polycrystalline materials. Numerical modelling of the solid-state properties of the solar cell showed to be an unnecessary, complex and a very time-consuming method. Model building from regression analysis on a set of measurements was abandoned due to the lack of flexibility. The applied model was instead the so-called 'Sandia' model. The model scopes the spectral and optical response, the temperature dependence and the beam and diffuse irradiances influence. The model worked well for fluctuating operational conditions and can easily be modified to work for other solar cell material. The Sandia model was implemented in Mathcad® together with a solar radiation program to calculate the energy input to the solar module. Own experiments were conducted to aid the model validation and to transform the model to work for a new solar cell. Measurements were taken of the short circuit current, the open circuit voltage and the entire IV curve. The available equipment limited the possible analysis. The model validation showed that the model has a tendency to over-predict the measured values. The systematic over-prediction suggests that the model cannot explain all of the deterministic information in the solar cell. Comprehensive error analysis suggests an uncertainty of <10%.

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Development of guided tissue regeneration/guided bone regeneration membranes for periodontal regeneration

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Periodontitis is the gum infection that degrades the four tooth-supporting tissues of the periodontium, i.e., gingiva, periodontal ligament, cementum and bone. The rate of periodontal breakdown has significantly increased in patients since last few years. Recent therapies are unable to totally regenerate all four tissues. Guided Tissue Regeneration (GTR) and Guided Bone Regeneration (GBR) are techniques being used extensively for treatment of periodontitis. In both these cases, an occlusive periodontal membrane acts as a barrier to prevent epithelial and connective tissues down-growth into the defect and thus enables periodontal regeneration. Existing membranes suffer from problems like unpredictable resorption time, heterogeneity, microbial attack, low mechanical strength, difficult to handle, high price and unacceptability by patients. GTR/GBR membranes have been synthesized using bioactive ceramic material (bioactive glass) with composition of SiO_2: CaO: P_2O_5 with polymers chitosan, alginate and PCL. Kaolin and bentonite clays have been used in these membranes to increase their stability and mechanical properties. The membranes have been prepared by freeze drying and electrospinning techniques. The synthesized membranes were characterized by Fourier Transform Infrared Spectroscopy (FTIR), Brunauer-Emmett-Teller (BET) surface area analyzer, X-Ray Diffraction (XRD) and Thermogravimetric Analysis-Differential Scanning Calorimetry (TGA-DSC). Results indicate that both structural and thermal properties of membranes are highly influenced by addition of clays. The addition of clay can control the swelling rate and degradation rate by altering the pore to volume ratio, which further improves the mechanical stability. The biological and physical characterization revealed that the fabricated membrane possesses excellent biological and mechanical properties.

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