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Predictive Formula for Electron Range over a Large Span of Energies

[1] ANNE STARLEY, GERGORY WILSON, JOHN DENNISON, LISA PHILLIPPS, Utah State University — A model has been developed to predict the approximate penetration depth into diverse classes of materials for a broad range of energetic incident electrons (<10 eV to >10 MeV, with better than 20% accuracy). The penetration depth—or range—of a material describes the maximum distance electrons can travel through a material, before losing all of its incident kinetic energy. This model leads to a predictive formula that estimates the penetration depth for materials without the need for supporting data, but rather using only basic material properties and a single fitting parameter (N_v, described as the effective number of valence electrons). N_v was first empirically calculated for 247 materials which have tabulated range and inelastic mean free path data in the NIST ESTAR and IMFP databases. Correlations of N_v with key material constants (atomic number, atomic weight, density, and band gap) were established for this set of materials. These correlations allow prediction of the range for additional materials which have no supporting data. Estimates for both simple compounds (*e.g.*, BnN and AlN) and complex biological materials (*e.g.*, brain tissue and cortical bone tissue) are presented, along with tests of the validity and accuracy of the predictive formula. These calculations are of great value for studies involving high electron bombardment, such as electron spectroscopy, spacecraft charging or electron beam therapy.

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