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Impact of ion and neutral angular distribution on thin film deposition in HiPIMS and bipolar HiPIMS

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Unipolar and bipolar High Power Impulse Magnetron Sputtering (HiPIMS) are widely used techniques for depositing superconducting thin films, utilizing various magnetron configurations such as planar and cylindrical. In this study, ion energy and flux were measured from both planar and cylindrical magnetrons under varying pressure and power conditions, using mass spectrometry and Retarding Field Energy Analyzers (RFEA). To investigate the angular dependence of these configurations, diagnostics were performed over a full 180° sweep of the sputtered material. A Langmuir probe was employed to measure the current-voltage (I-V) characteristics of the plasma. The angular dependence of the deposition rate was evaluated using a charge-selective quartz crystal microbalance and compared across the different magnetron configurations. Superconducting Nb films were then deposited at various angular positions, with substrates either grounded or biased, and analyzed via X-ray Photoelectron Spectroscopy (XPS) and Scanning Electron Microscopy (SEM). The findings of this work provide insights into optimizing deposition rates and film growth, with potential in enhancing 1.3 GHz cavity coating.

Footnotes

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Author: SIMON, Stephane (The University of Liverpool)

Co-authors: BENJAMIN, Christopher (Science and Technology Facilities Council); BRADLEY, James (Cockcroft Institute); VALIZADEH, Reza (Science and Technology Facilities Council)

Presenter: SIMON, Stephane (The University of Liverpool)

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