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Metallic neutral vapours diffusion in electron cyclotron resonance ion sources : fluid dynamics and particle tracing simulations

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Resistive oven technique is used to inject vapours of metallic species in plasma traps, where plasma sustained by the electron cyclotron resonance (ECR) mechanism provides step-wise ionisation of neutral metals, producing charged ion beams for accelerators. We present a numerical survey of metallic species suitable for oven injection in ECR ion sources to explore neutrals diffusion and deposition, under molecular flow regime. These aspects depend on geometry of the evaporation inlet, thermodynamics, and on plasma parameters, which strongly impact on ionisation and charge-exchange rate, thus on the fraction of reacting neutrals. We considered diffusion of metals with and without plasma, and the impact of a liner for re-emitting deposited species. Numerical predictions might be relevant to reduce the metal consumption and to increase the overall efficiency. As test beams, we simulated most relevant ones for modern nuclear physics field, such as ^{48}Ca and rare earths species.

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