

Q-One platform: Dual Source Focus Ion Beam System for Scalable, Precise, And Reliable positioning of colour centres

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Colour centres in diamond are a key enabling technology for quantum devices, with Nitrogen-Vacancy (NV) and group-IV centres such as Tin-Vacancy (SnV) attracting particular interest. Realising functional quantum devices based on these systems critically depends on ion implantation tools capable of delivering precise, repeatable, and scalable placement of dopant atoms, together with compatibility with post-implantation processing.

The main technological challenges lie in achieving nanometre-scale spatial accuracy, controlled ion species selection, and dose repeatability, while maintaining throughput suitable for scalable device fabrication. Addressing these requirements places stringent demands on focused ion beam (FIB) system design, source flexibility, and long-term operational stability.

At the 2025 EIPBN conference, we introduced a two-year joint development project aimed at defining a process for the scalable, precise, and reliable positioning of colour centres in diamond. The project, partially funded by Innovate UK, brings together Ionoptika, the University of Surrey, Fraunhofer Institute for Applied Solid State Physics (IAF), and XeedQ GmbH, combining FIB system development, advanced materials processing, and quantum device expertise.

Within this project, Ionoptika developed a novel dual-source, single-column focused ion beam system based on the well-established Q-One platform. The system integrates both a liquid metal alloy ion source and a plasma ion source within a single column architecture, enabling flexible implantation of nitrogen, tin, and other relevant species while preserving the beam stability, resolution, and placement accuracy of the Q-One system.

In this year's EIPBN contribution, we will report on final results and conclusions of studies carried out with existing Q-One systems at Surrey University in collaboration with the other partners, Fraunhofer IAF and XeedQ, and present the performance, design considerations, and capabilities of the newly developed dual-source, single-column Q-One instrument.