Automated Electron Diffraction: A New Tool for Solid-State Characterization in the Pharmaceutical Industry

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The demand for rapid, reliable, and comprehensive solid-state characterization is growing in pharmaceutical development, especially in the context of form screening and impurity profiling [1]. Automated electron diffraction (microED) is emerging as a powerful technique that complements and extends traditional methods such as PXRD and single-crystal X-ray diffraction, particularly for microcrystalline and nanocrystalline materials. [2,3]

In this poster, we introduce the ELDICO *ED-1*, a dedicated electron diffractometer designed specifically for automated and high-throughput electron diffraction experiments. With its optimized geometry, precise and accurate rotation stage, and multi-sample holder, the ELDICO *ED-1* enables automatic and high-throughput structure elucidation from crystals as small as a few hundred nanometers—with very low or without requiring human efforts.
We present two pharmaceutical case studies highlighting the versatility of automated microED:

1. a high-throughput form screening campaign where multiple solid forms were successfully identified and structurally characterized from screening total of 100 nanocrystals from different samples. Furthermore, the results were compared to Crystal Structure Prediction (CSP) results.
2. the identification of various crystalline phases in spray-dried samples, providing valuable insight into polymorphism and phase composition.

These examples demonstrate the potential of automated electron diffraction as a robust and efficient tool for routine solid-state analysis in drug development workflows. Moreover, they enhance the applicability of microED experiments as a complementary technique that detects crystalline forms present in sub-microgram (or traces) amounts.

Purpose

The need for fast, reliable, and comprehensive solid-state characterization is growing in pharmaceutical development, especially in early-phase workflows such as form screening and impurity profiling. Traditional techniques like PXRD and single-crystal X-ray diffraction are often limited when working with microcrystalline or nanocrystalline materials. This study

explores the use of automated electron diffraction (microED) as a complementary technique, using the ELDICO *ED-1*, to address these challenges.

Method
The ELDICO *ED-1* is a dedicated electron diffractometer optimized for automated, high-throughput structure determination. It features a fixed beam-sample-detector geometry, a high-precision rotation stage, and a multi-sample holder system. These design elements enable unattended acquisition and analysis of electron diffraction data from crystals as small as a few hundred nanometers. Two pharmaceutical case studies will be presented.

Conclusion
These case studies demonstrate that automated microED using the ELDICO *ED-1* is a robust, efficient, and practical tool for routine solid-state characterization in drug development. The system enables structure determination from nanocrystalline and trace-level samples with minimal human intervention, running 24/7 in a high-throughput environment. This makes it especially valuable for workflows where traditional techniques may fall short.

Automated microED expands the analytical toolbox available to pharmaceutical scientists, offering rapid turnaround times, ease of use, and structural insight at the nanometre scale—thereby accelerating decision-making in formulation, development, and quality control.

Keywords:
(microED, automation, polymorphism, impurity, screening)