Utilizing Scanning Electron Microscopy to Enhance Research Through Advanced Imaging

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Introduction. Scanning electron microscopy (SEM) is an imaging technique that utilizes a focused beam of electrons to generate highly detailed images showcasing the surface morphology and composition of a given material. The interaction between the electrons and the sample produces signals that provide insight into the material's structural and elemental properties.

Goal. The primary objective was to examine surface characteristics in 3D printed polylactic acid (PLA)- and resin-based scaffolds used in bone marrow analog culture systems.

Methods. We aligned the electron beam and adjusted shift and tilt to ensure accurate imaging of surfaces**.** Shift helped to directly center the beam by modifying its lateral movement whereas tilt altered the angle at which the beam hit the sample. SEM uses multiple detectors depending on the type of sample being examined. The Secondary Electron (SE) detector is best suited for conductive materials such as metals. Additionally, wobble (to reduce beam oscillation) and astigmatism (to correct distortions) were finely calibrated to yield high-quality images. To image the various types of non-conductive scaffolds the Cascade Current Detector (C2D) and variable pressure (VP) option were chosen since they reduce the effects of localized charging due to the buildup of electrons on the non-conductive material surface.

Results. It was observed that the resin-based scaffold exhibited a more regular surface texture compared to the PLA scaffolds. The PLA scaffolds were distinguished by a more rough and porous texture, whereas the resin scaffolds presented a more uniform, impermeable structure. Optimizing SEM imaging is critical for material surface morphology analysis. This investigation allowed us to image non-conductive material, such as PLA and resin-based scaffolds in high-resolution.

Conclusion. By using proper SEM imaging parameters, we achieved high resolution images of material surface topography and may clearly visualize surfaces designed for cell attachment.

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