APPLICATION NOTE

Pharmaceutical research with a desktop SEM

Application of the Phenom Desktop SEM in the pharmaceutical research field

Pharmaceutical research involves creation of new drugs or continuous improvement of existing drugs. It is a broad field of study dealing with an increasing number of challenges. New pathogens are emerging constantly and known pathogens are rapidly developing resistance to existing drugs.

The power of desktop SEM

Since more information is needed, the use of advanced tools, such as a scanning electron microscope (SEM), has been shown to be very powerful in various applications in the pharmaceutical field. In pharmaceutical research, SEMs are used for powder imaging and analysis, to gain insights into cellular interactions with new drugs, and for applications in the most complicated cancer treatments.

This article discusses a few examples to illustrate the successful application of the Thermo Scientific™ Phenom Desktop SEM in research facilities across the world to develop novel and more powerful drugs to treat diseases.

Superporous hydrogels

A research team at AIMST University in Malaysia is involved in the development of a new class of superporous hydrogel beads. Hydrogels consist of a network structure of cross-linked hydrophilic polymers that are capable of absorbing water in large amounts without dissolving. These beads are employed as carriers in pharmaceuticals for controlled drug delivery based on their biodegradation and swelling abilities. Since a targeted drug delivery eliminates side effects on other cells or tissues, it helps achieve easier and faster regeneration.

With developments in research, and the increasing need to develop enhanced and highly performing drugs, the researchers have developed a new class of hydrogels with rapid swelling capacities—the reason for the name “Superporous Hydrogels”. Here, the researchers examined the surface structure and porosity of the dried beads using an SEM.

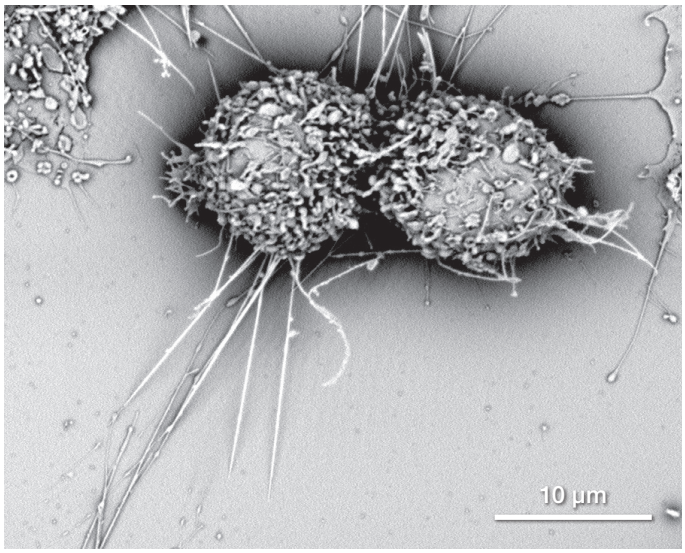

Figure 1. An example of mammalian cells observed with SEM

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Cancer drug research

A new kind of approach was used in cancer drug research. It was found that aromatase, an enzyme responsible for determining the final sex phenotype of fish, was also playing a key role in the progression of breast cancer. Therefore, in a study, researchers used aromatase inhibitors for breast cancer treatment.

In fish, androgens are irreversibly converted into estrogens by aromatase enzymes, thereby establishing the embryo's gender to female. Researchers are showing more interest to study male fish than female fish of this species because male fish generate anti-aromatase in large quantities.

Like Nile tilapia, which gained attention as a source of food worldwide, aromatase obtained from this fish was the subject of interest for researchers looking for aromatase inhibitors.

Nile tilapia microsomes were used to study the enzyme activity of aromatase inhibitors. They are vesicle-like fractions of the endoplasmic reticulum (ER) present in healthy living cells. In this study, hepatic microsomes were prepared from Nile tilapia and their morphology was explored using an SEM.

The proliferation of cancer cells was investigated using HepG2 human hepatoma cells and MCF-7 human breast cancer cells. The study results revealed that the growth of both cancer cell lines was efficiently inhibited by a specific anti-aromatase present in microsomes.

Moreover, the morphology of tissues needs to be analyzed and understood. At present, this can be achieved using the correlated light and electron microscopy (CLEM) technique.

Development of antibacterial agents

Antibiotics are excessively used and as a result, the prevalence of antibiotic resistant bacteria is on the rise. Hence, researchers are seeking new ways detect bacteria on medical devices to prevent nosocomial (hospital-acquired) infections. Extensive research is going on in the development of new antibacterial agents.

A study revealed that pathogens present on medical devices can be destroyed when ZnO and Ag-ZnO crystals are added. Here, an SEM was used to analyze the elemental composition and morphology of the crystals before using them for further experiments. In addition, as a means of performing quality control, an SEM can be used to study the efficacy of the coating process. Software can easily detect the difference between coated and uncoated regions.

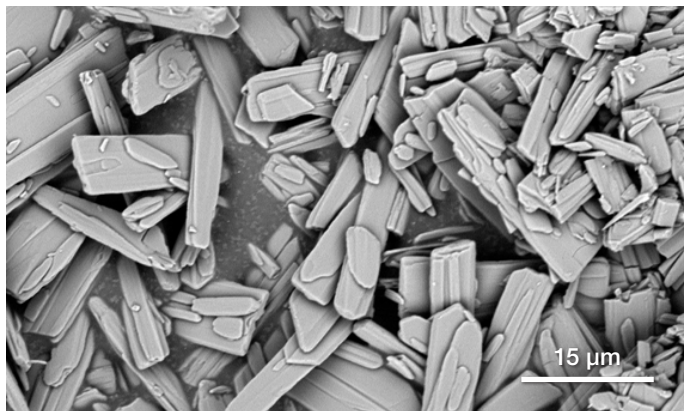

Figure 2. Crystalized pharmaceutical agents observed with SEM.

Conclusion

In summary, scanning electron microscopes are versatile tools that can be used for various research activities in the pharmaceutical industry. They can help researchers study the morphology of the component of interest and highlight the effect of interactions with its environment.

References

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